

THURSDAY, DECEMBER 19, 1878

PARADOXICAL PHILOSOPHY

Paradoxical Philosophy. A Sequel to the "Unseen Universe." (London: Macmillan and Co., 1878.)

ON opening this book, the general appearance of the pages, and some of the phrases on which we happened to light made us somewhat doubtful whether it lay within our jurisdiction, as it is not the practice of NATURE to review either novels or theological works.

In the dedication, however, the book is described as an account of the *Proceedings* of a learned society, a species of literature which we are under a special vow to rescue from oblivion, even when, as in this case, the proceedings are those of one of those jubilee meetings, in which learned men seem to aim rather at being lively than scientific.

On the title-page itself there is no name to indicate whether the author is one of those who by previous conviction have rendered themselves liable to our surveillance, but on the opposite page we find "The Unseen Universe; or, Physical Speculations on a Future State," to which this book is a "Sequel," ascribed to the well-known names of Balfour Stewart and P. G. Tait.

Mr. Browning has expressed his regret that the one volume in which Raffaele wrote his sonnets, and the one angel which Dante was drawing when he was interrupted by "people of importance," are lost to the world. We shall therefore make the most of our opportunity when two eminent men of science, "driven," as they tell us, "by the exigencies of the subject," have laid down all the instruments of their art, shaken the very chalk from their hands, and, locking up their laboratories, have betaken themselves to those blissful country seats where Philonous long ago convinced Hylas that there can be no heat in the fire and no matter in the world; and where in more recent times, Peacock and Mallock have brought together in larger groups the more picturesque of contemporary opinions.

In this book we do not indeed catch those echoes of well-known voices in which the citizens of the "New Republic" tell us how they prefer to regard themselves as thinking, taking care, all the while, that no actual thought shall disturb their enjoyment of the luxury of extravagant opinion. The members of the Paradoxical Society, with their guest, Dr. Hermann Stofkraft, are far too earnest to adopt this pose of mind, but they exhibit that sympathy in fundamentals overlaid with variety in opinions which is one of the main conditions of good-fellowship. Dr. Stofkraft, in spite of his name and of his office as the single-handed opponent of the thesis of the book, makes it his chief care so to brandish his materialistic weapons as not to hurt the feelings of his friends; and when, near the end of the book, he gets a little out of temper, it is about matters with which a materialist, as such, has no concern.

As the book is not a novel there is no literary reason for not telling "what became of the Doctor," as narrated in the last chapter. He goes to Strathkelpie Castle to take part in an investigation of spiritualistic phenomena. He begins by detecting the mode in which one young lady performs her spirit-rapping, but forthwith falls into an

"electro-biological" courtship of another, and, this proving successful, he is persuaded by his wife and her priest to renounce the black arts in the lump as works of the foul fiend; and then we are told that, having quieted his spirit by a few evolutions in four dimensions, he has now settled down to compose his "Exposition of the Relations between Religion and Science," which he intends to be a thoroughly matured production.

The Doctor—and, indeed, most of the other characters—are no mere materialised spirits, or opinions labelled with names of the *Euphranor* and *Alciphron* type. They do not reduce their subject to a *caput mortuum* by an exhaustive treatment, but take care, like well-bred people, to drop it and pass on to another before we have time to suspect that the last word has been said.

We cannot accuse the authors of leading us through the mazy paths of science only to entrap us into some peculiar form of theological belief. On the contrary, they avail themselves of the general interest in theological dogmas to imbue their readers at unawares with the newest doctrines of science. There must be many who would never have heard of Carnot's reversible engine, if they had not been led through its cycle of operations while endeavouring to explore the Unseen Universe. No book containing so much thoroughly scientific matter would have passed through seven editions in so short a time without the allurements of some more human interest.

Nor need we fear to draw down on NATURE the admonition which fell on the inner ear of the poet—

"Thou pratest here where thou art least;
This faith hath many a purer priest,
And many an abler voice than thou."

For even those words and phrases which seemed at first sight to remove the book from the field of our criticism, are found on a nearer view to have acquired a new, and indeed a *paradoxical* sense, for which no right of sanctuary can be claimed.

The words on the title-page: "In te, Domine, speravi, non confundar in æternum," may recall to an ordinary reader the aspiration of the Hebrew Psalmist, the closing prayer of the "Te Deum," or the dying words of Francis Xavier; and men of science, as such, are not to be supposed incapable either of the nobler hopes or of the nobler fears to which their fellow-men have attained. Here, however, we find these venerable words employed to express a conviction of the perpetual validity of the "Principle of Continuity," enforced by the tremendous sanction, that if at any place or at any time a single exception to that principle were to occur, a general collapse of every intellect in the universe would be the inevitable result.

There are other well-known words in which St. Paul contrasts things seen with things unseen. These also are put in a prominent place by the authors of the "Unseen Universe." What, then, is the Unseen to which they raise their thoughts?

In the first place the luminiferous æther, the tremors of which are the dynamical equivalent of all the energy which has been lost by radiation from the various systems of grosser matter which it surrounds. In the second place a still more subtle medium, imagined by Sir William Thomson as possibly capable of furnishing an explana-

tion of the properties of sensible bodies; on the hypothesis that they are built up of ring vortices set in motion by some supernatural power in a frictionless liquid: beyond which we are to suppose an indefinite succession of media, not hitherto imagined by any one, each manifoldly more subtle than any of those preceding it. To exercise the mind in speculations on such media may be a most delightful employment for those who are intellectually fitted to indulge in it, though we cannot see why they should on that account appropriate the words of St. Paul.

NATURE is a journal of science, and one of the severest tests of a scientific mind is to discern the limits of the legitimate application of scientific methods. We shall therefore endeavour to keep within the bounds of science in speaking of the subject-matter of this book, remembering that there are many things in heaven and earth which, by the selection required for the application of our scientific methods, have been excluded from our philosophy.

No new discoveries can make the argument against the personal existence of man after death any stronger than it has appeared to be ever since men began to die, and no language can express it more forcibly than the words of the Psalmist:—

"His breath goeth forth, he returneth to his earth; in that very day his thoughts perish."

Physiology may supply a continually increasing number of illustrations of the dependence of our actions, mental as well as bodily, on the condition of our material organs, but none of these can render any more certain those facts about death which our earliest ancestors knew as well as our latest posterity can ever learn them.

Science has, indeed, made some progress in clearing away the haze of materialism which clung so long to men's notions about the soul, in spite of their dogmatic statements about its immateriality. No anatomist now looks forward to being able to demonstrate my soul by dissecting it out of my pineal gland, or to determine the quantity of it by the process of double weighing. The notion that the soul exerts force lingered longer. We find it even in the late Isaac Taylor's "Physical Theory of a Future State." It was admitted that one body might set another in motion; but it was asserted that in every case, if we only trace the chain of phenomena far enough back, we must come to a body set in motion by the direct action of a soul.

It would be rash to assert that any experiments on living beings have as yet been conducted with such precision as to account for every foot-pound of work done by an animal in terms of the diminution of the intrinsic energy of the body and its contents; but the principle of the conservation of energy has acquired so much scientific weight during the last twenty years that no physiologist would feel any confidence in an experiment which showed a considerable difference between the work done by an animal and the balance of the account of energy received and spent.

Science has thus compelled us to admit that that which distinguishes a living body from a dead one is neither a material thing, nor that more refined entity, a "form of energy." There are methods, however, by which the application of energy may be directed without interfering

with its amount. Is the soul like the engine-driver, who does not draw the train himself, but, by means of certain valves, directs the course of the steam so as to drive the engine forward or backward, or to stop it?

The dynamical theory of a conservative material system shows us, however, that *in general* the present configuration and motion determines the whole course of the system, exceptions to this rule occurring only at the instants when the system passes through certain isolated and singular phases, at which a strictly infinitesimal force may determine the course of the system to any one of a finite number of equally possible paths, as the pointsman at a railway junction directs the train to one set of rails or another. Prof. B. Stewart has expounded a theory of this kind in his book on "The Conservation of Energy," and MM. de St. Venant and Boussinesq have examined the corresponding phase of some purely mathematical problems.

The science which rejoices in the name of "Psychophysik" has made considerable progress in the study of the phenomena which accompany our sensations and voluntary motions. We are taught that many of the processes which we suppose entirely under the control of our own will are subject to the strictest laws of succession, with which we have no power of interfering; and we are shown how to verify the conclusions of the science by deducing from it methods of physical and mental training for ourselves and others.

Thus science strips off, one after the other, the more or less gross materialisations by which we endeavour to form an objective image of the soul, till men of science, speculating, in their non-scientific intervals, like other men on what science may possibly lead to, have prophesied that we shall soon have to confess that the soul is nothing else than a function of certain complex material systems.

Men of science, however, are but men, and therefore occasionally contemplate their souls from within. Those who, like Du Bois-Reymond, cannot admit that sensation or consciousness can be a function of a material system, are led to the conception of a double mind.

"On the one side the acting, inventing, unconscious material mind, which puts the muscles into motion, and determines the world's history; this is nothing else but the mechanics of atoms, and is subject to the causal law, and on the other side the inactive, contemplative, remembering, fancying, conscious, immaterial mind, which feels pleasure and pain, love, and hate; this one lies outside of the mechanics of matter, and cares nothing for cause and effect."

We might ask Prof. Du Bois-Reymond which of these it is that does right or wrong, and knows that it is his act, and that he is responsible for it, but we must go on to the other view of the case, which Dr. Stofkraft alludes to at p. 78, although by some law of the *Paradoxical*, he is not allowed to pursue a subject which might have afforded excellent sport to the Society.

"I feel myself compelled to believe," says the learned Doctor, "that all kinds of matter have their motions accompanied with certain simple sensations. In a word, all matter is, in some occult sense, alive."

This is what we may call the "levelling up" policy, and it has been expounded with great clearness by Prof.

von Nägeli in a lecture, of which a translation was given in *NATURE*, vol. xvi. p. 531.

He can draw no line across the chain of being, and say that sensation and consciousness do not extend below that line. He cannot doubt that every molecule possesses something related, though distantly, to sensation, "since each one feels the presence, the particular condition, the peculiar forces of the other, and, accordingly, has the inclination to move, and under circumstances really begins to move—becomes alive as it were;" . . . "If therefore, the molecules feel something which is related to sensation, then this must be pleasure if they can respond to attraction and repulsion, *i.e.*, follow their inclination or disinclination; it must be displeasure if they are forced to execute some opposite movement, and it must be neither pleasure nor displeasure if they remain at rest."

Prof. von Nägeli must have forgotten his dynamics, or he would have remembered that the molecules, like the planets, move along like blessed gods. They cannot be disturbed from the path of their choice by the action of any forces, for they have a constant and perpetual will to render to every force precisely that amount of deflexion which is due to it. Their condition must, therefore, be one of unmixed and unbroken pleasure.

But even if a man were built up of thinking atoms would the thoughts of the man have any relation to the thoughts of the atoms? Those who try to account for mental processes by the combined action of atoms do so not by the thoughts of the atoms, but by their motions.

Dr. Stoffkraft explains the origin of consciousness at p. 77 and at p. 107. We recommend to his attention Mr. Herbert Spencer's statement in his "Principles of Psychology," § 179, where he shows in a most triumphant manner how, under certain circumstances, "there must arise a consciousness." Such statements, carefully studied, may contribute to the further progress of science in the path which we have been describing, by showing more clearly that consciousness cannot be the result of a plexus of nervous communications any more than of a congeries of plastidule souls.

Personality is often spoken of as if it were another name for the continuity of consciousness as reproduced in memory, but it is impossible to deal with personality as if it were something objective that we could reason about. My knowledge that I am is quite independent of my recollection that I was, and also of my belief that, for a certain number of years, I have never ceased to be. But as soon as we plunge into the abysmal depths of personality we get beyond the limits of science, for all science, and, indeed, every form of human speech, is about objects capable of being known by the speaker and the hearer. Whenever we pretend to talk about the Subject we are really dealing with an Object under a false name, for the first proposition about the Subject, namely, "I am," cannot be used in the same sense by any two of us, and therefore can never become part of science at all.

The progress of science, therefore, so far as we have been able to follow it, has added nothing of importance to what has always been known about the physical consequences of death, but has rather tended to deepen the distinction between the visible part, which perishes before

our eyes, and that which we are ourselves, and to show that this personality, with respect to its nature as well as to its destiny, lies quite beyond the range of science.

J. CLERK MAXWELL

SCIENCE CLASS-BOOKS

The London Science Class-Books. Edited by G. Carey Foster, F.R.S., and Philip Magnus, B.Sc. *Biological Series.* 1. *Botany—Outlines of Morphology and Physiology.* 2. *Botany—Outlines of Classification of Plants.* By W. Ramsay McNab, M.D. 3. *Zoology of the Vertebrate Animals.* 4. *Zoology of the Invertebrate Animals.* By Prof. A. Macalister. (London: Longmans, Green and Co., 1878.)

THE editors of this series of Elementary Science Class-Books intend that the works shall all be composed with special reference to school teaching; that they shall be suited to the capabilities and comprehension of boys and girls during their school course, while they shall at the same time afford trustworthy and accurate information presented in such a way that it may serve as a basis for more advanced study. In thus announcing their scheme the editors would seem to indicate that they have learned to appreciate the very great want that exists in all our public schools of just such a series of class-books as they undertake to supply; and though the standard at which they aim cannot be regarded as a high one, still most judges will agree that it is both a suitable and a proper one, and it is one that we wish the editors every success in their carrying of it out. If the natural sciences are to be taught in our schools the scholars must have class-books of these sciences, and we take it as a good sign that the demand for such class-books is in this new series being supplied. The information in the present series is to be accurate and trustworthy, and the names of the authors of the four books already published of the biological series is a sufficient guarantee that this is so. The information is to be suited to the capabilities of girls and boys during their school-days, and still it is to be presented in such a way as to form the basis of a higher study. The authors' names, however distinguished, will be no necessary guarantee of this. It is not given to every one to be able to write an elementary book that may serve as the basis for a more advanced study. In the first two class-books on our list the author indeed does not even make the attempt. In his preface Prof. McNab declares that it has been thought advisable to make his class-books on Botany such as would serve as a basis for the teaching in the higher classes of schools, and such as would supply the wants of medical students and others wishing to acquire a knowledge of the subject. We think this a pity, for we certainly at once miss that strictly elementary treatment of the subject, that full statement and discussion of the fundamental facts thereof, which we were led to expect, not by the author, but by his editors; and however useful and instructive these two class-books may be, the aim that we fancy they should have kept in view is lost in the endeavour, to quote their authors' own words, that they should "serve as an introduction to the celebrated textbook of the distinguished German botanist, whose "Lehr

buch der Botanik" has been lately translated by Professors Bennett and Thiselton Dyer, and which has been published in the Clarendon Press Series. After the class-book is mastered the manual is to be studied."

The first class-book treats of the morphology and physiology of plants. In it three chapters are devoted to the morphology, and five chapters to the physiology. Like the little text-book of Thomé, it presents to the student's view a cell of a fungal plant, as an instance of the simplest conception of a vegetable cell; but while such a structure is a cell, surely it is neither the most simple, nor certainly is it the most perfect form of a cell to be the first given to a beginner. The structure of the cell-wall and its growth are well treated of, but we do not like to find the word "absorption" used in the account of the formation of wood vessels, bordered pits, &c.; this word is very likely to mislead the student, especially when he finds it used in another chapter to denote the imbibition of moisture. So far as we know, the cellulose cell-wall is in no case decomposed molecule by molecule, and these are not taken up as they are laid down; and yet would it not require that all this should be done ere the term internal absorption could be correctly applied?

The subjects of the formation of new cells, and of the substances contained in protoplasm, are thoroughly well done; a few technical words here and there occurring, and not explained, will demand the attention of the teacher. It would have been well had the chemical formulæ for starch, and some of the other members of the cellulose group, be given, in addition to the formula for cellulose. Such formulæ would have enabled the student the better to understand the change of one organic compound, such as starch, into another, such as sugar. In passing we may observe that Sach's "Text-Book" is very defective also in this respect; indeed, the word sugar is not to be found in its index, and nowhere in the text is its composition given. Chapter II. treats of the tissues. Perhaps a few more technical words are here used than are absolutely necessary, but no doubt a great deal of exactness is attained by their use. The details are compressed into the smallest compass, but are quite up to the very newest facts; and because each word in such a chapter stands to express a good deal, we venture to take exception to the employment of the word development in the following sentence:—"Permanent tissue is formed by the further development of those cells of the meristem which have lost the power of dividing," and which have assumed some permanent form. It is just in such cells that no true development can take place. In Chapter III. the external conformation of plants is briefly treated of. In Chapter IV. we find The Nutrition of Plants. "As the chemical elements out of which the plant constructs its organic substance," the author enumerates "carbon, hydrogen, oxygen, nitrogen, and sulphur;" might he not have added iron? True, it may still be doubted whether iron forms an integral constituent of the chemical formula of chlorophyll, but without it the plant, as a plant, cannot "construct its organic substance." The processes of assimilation and metastasis are very conveniently tabulated, and the student carefully going over this chapter will, we should think, be able to understand it without any help from a teacher. It is a

chapter which does the author great credit, and almost comes up to the standard of the editors. Only one comment we venture to make on it. Taking it for granted that Nägeli has somewhere said that the *ultimate* solid particles of plants are more or less crystalline, a conception beyond our powers, how then can the mode of their growth be very different from that occurring in minerals, crystals, &c.? The Fifth Chapter is concerned with the relation of the general conditions of the life of plants. The Sixth treats of the growth of plants. The author limits the term growth to an increase in bulk, accompanied by a deposit of some new constructive material. He thus considerably limits the term, as we believe correctly defined by Herbert Spencer. The subject of the tension found in growing parts is treated at a length out of due proportion to the treatment of the other subjects in the volume, and in such a class-book we think it would have sufficed to have given the results of Sachs' experiments on the periodicity of growth, and not to have copied his tabular statements in such detail. The last chapters are devoted to the subjects of the reproduction of plants and their classification.

The second class-book, also by Prof. McNab, is a continuation of the first, but is devoted to the special morphology and outlines of a classification of plants. The classification of the flowerless plants is based on that of Sachs, though this is here and there altered. We think the author acts rather prematurely in placing such families as those of the Chytridiaceæ and Chlorochytridiaceæ yet as among the Oosporeæ. The Lichens are regarded as ascomycetous fungi parasitic on algæ; this we think right. Cohn's very convenient names Bryophyta and Pteridophyta are adopted for the groups of the mosses and the Vascular Cryptogams; and as an instance that very recent facts in the life history of the Cryptogams has not escaped the attention of the author, we perceive that he mentions that the branches of the Horse-tails arise in an axillary manner, and not as believed up to Janczewski's researches, in an endogenous manner. So much space is devoted to the Cryptogams that the treatment of the flowering plants is greatly curtailed. These two little volumes have been well and painstakingly compiled; they may be safely placed in the hands of a student who knows some little of the subject about which they treat, and they cannot fail to be very useful to every teacher of the natural sciences in our upper schools.

The two little volumes on "Zoology," by Prof. Macalister, are of quite another type. They aim at presenting, in as simple a form as possible, the leading characters of vertebrate and invertebrate animals. In these, special care has been taken to dispense with all unnecessary technicalities, and when such, owing to the nature of the case, arise, they are carefully explained. We would have wished something more novel than most of the woodcut illustrations, though we acknowledge that among the invertebrates some of the illustrations are modern; but we feel glad to find each volume with a carefully drawn up index, the loss of which will doubtless be felt by many a student of Prof. McNab's two class-books; while they will be found to afford trustworthy and accurate information. This will be found given in a way quite suited to the comprehension of our average minded girls and boys.

OUR BOOK SHELF

Studies from the Physiological Laboratory in the University of Cambridge. Edited by the Trinity Prælector in Physiology. Part III. (Cambridge: Printed at the University Press, 1877.)

THIS volume of 165 pages, together with numerous elaborate plates—the largest of the Cambridge Biological “Studies” yet published—is a most pleasing indication of a vigorous spirit of research in a body which has by many been thought to be solely educational. It is not, indeed, the number of the memoirs and papers here collected, but their quality, which makes them worthy of the university whose name they bear on the title-page. In quantity they are far from commensurate with the latent means and opportunities of the colleges and University of Cambridge, but in their thoroughness and dignity they display a spirit which would do honour to any university. They represent a new feature in the history of biological science in this country, viz., the recognised official charge of biological research in high places, where it has been too long neglected. The Biological and Physiological School of Cambridge is a rare and valuable “sport” in the offspring of an organism of decided conservative tendencies: may we not hope that, ere long, Oxford will give birth to a similar healthy monster?

All the papers of this volume have been published before in the *Journal of Anatomy and Physiology*, or elsewhere; but we are not the less glad, on that account, to see the present collection. If the cause of scientific research were more secure in England than it is, the publication of special collections of memoirs of the various schools might be held to be an unnecessary luxury, or even—since rivalry may become ungenerous—a positively dangerous habit. Under our present conditions, however, it is not only pleasant to be reminded now and again of the various centres of organised research among us, but it materially strengthens the hands of English scientific workers to invest the different growing schools with somewhat of a personal and individual interest.

The volume contains physiological and anatomical papers, chiefly in zoology, but also in botany. Dr. Michael Foster and Mr. Dew-Smith contribute a most interesting paper on the effects of the constant current on the heart, which is a continuation of the work they did on the reaction of the snail's heart to electrical currents. Mr. J. N. Langley has a paper on the action of pilocarpin on the submaxillary gland of the dog. Mr. Gaskell reprints one of his papers on the vaso-motor nerves of striated muscles. Mr. F. M. Balfour contributes an important section of his now published monograph on the development of elasmobranch fishes, viz., the development of their spinal nerves; as well as a paper on the spinal nerves of amphioxus. Mr. Marshall follows with a paper on the development of the nerves in birds. Mr. Bullar has a paper, with plates, on the generative organs of parasitic isopoda; Mr. Bridge one on the cranial osteology of *Amia calva*, also admirably illustrated; and Mr. Sidney Vines a short communication on the digestive ferment of nepenthes.

The American Quarterly Microscopical Journal, containing the Transactions of the New York Microscopical Society. Edited by Romya Hitchcock. Vol. I., No. 1. October. (New York: Hitchcock and Hall, 1878.)

COMMENCING, as this new journal does, on the lines of our own *Quarterly Journal of Microscopical Science*, and somewhat under the like auspices, we trust it may have the same worthy career, and be equally well thought of. The first number is beautifully printed on excellent paper, and contains some eighty-two pages belonging to the journal proper, while the *Transactions* of the New York Microscopical Society extend to some sixteen pages more.

The six plates, on their part, are good, but not up to the same standard of execution as the letterpress, and fall a good deal below those that generally appear in our own microscopical journal. The chief contents of this part are—1. On the Sting of the Honey Bee, by J. D. Hyatt. Plates I. and II. 2. Description of some New Species of Diatoms, by H. L. Smith. Plate III. 3. Observations on several Forms of Saprolegniaceæ, by F. B. Hine. Plates IV. to VI. Only the first part of this paper is given, and the list of works referred to by the author is given at the end of the paper, so perhaps it may be premature to suggest that English writers on this subject are not altogether wanting, as he would seem to think; but has he not Dr. Lindstedt's Synopsis, and does not this refer to such? 4. The Oil Immersion Lenses of Zeiss compared with the Objectives of Spencer and Sons, by H. L. Smith. 5. On the Microscopical Examination of Fibers (fibres?), by W. H. Seaman. 6. Emigration in Passive Hyperæmia, by W. T. Belfield. 7. On a New Device for Dark-field Illumination, by W. Leighton. Among the shorter articles we may mention one reprinted, with full acknowledgment, on the Spore Formation in the Mesocarpeæ, from our own columns, and an account of the National Microscopical Congress held last August at Indianapolis, Indiana.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.]

[The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

Locusts and Sun-Spots

As the locust (*Edipoda migratoria*, or *Acridium perigrinum*?) is a frequent and occasionally aggravating accompaniment of drought and famine, it cannot but be interesting to notice that periodical incursions of this insect into the temperate zone are apparently regulated in some way by the terrestrial meteorological abnormalities which accompany the varying phases of the sun-spots.

Dr. F. G. Hahn, in his treatise “Ueber die Beziehungen der Sonnenfleckenperiode zu meteorologischen Erscheinungen,” after remarking that locusts will probably only visit the temperate regions in great numbers during unusually hot and dry years (on account of the brood), and abandon them again in wet and cold years, shows, from a list furnished by Dr. W. Köppen, of Hamburg, embracing the period 1800-1862, that in Europe they begin coming about the epoch of minimum sun-spot, paying annual visits from thence up to the epoch of maximum sun-spot, after which they disappear altogether until the next following epoch of sun-spot minimum.

In the following table I give Dr. Hahn's dates for their visitations in Europe, with some additional ones on the authority of M. Camille Flammarion, and Mr. Walford of the Statistical Society, which include other regions of the north temperate zone. I also give the corresponding sun-spot epochs in each case, according to Wolf. The capital letters in parentheses attached to the dates, indicate the authorities respectively alluded to above.

LOCUSTS.		SUN-SPOTS.	
Date of Visitation in Temperate Zone.		Min.	Max.
1613 (F)		1610.8	1615.0
1690 (F)		1689.5	1693.0
1748 ¹ -1749 (F)		1745.0	1750.3
1800 annually up to 1806 (H)		1798.3	1804.2
1811 “ “ 1816 (H)		1810.6	1816.4
1820 “ “ 1829 (H)		1823.3	1829.9
1832 (F) 1834 (F) 1837 annually up to 1839 (H)		1833.9	1837.2
1844 annually up to 1848 (H)		1843.5	1848.1
1855 “ “ 1862 (H)		1856.0	1860.1
1866 (F) 1868 (W)		1867.2	1870.6
1874 annually up to 1878 (W)		1877(?)	—

¹ See *Gentleman's Magazine* for July, 1748, pp. 332 and 474.

The remarkable fact displayed in his portion of the above table, that locusts only make their appearance in great numbers in the interval from minimum to maximum sun-spot and never during the interval from maximum to minimum sun-spot, is evidently regarded by Dr. Hahn as affording some additional collateral proof in favour of the relation he had already partially established between the rainfalls of Central Europe and the sun-spots, viz., that the interval from minimum to maximum sun-spot is in general drier and warmer than that from maximum to minimum sun-spot. The added dates apparently exhibit a relation to the sun-spot epochs similar to those given by Dr. Hahn.

Whether the laws which regulate the visitations of locusts are the same in other parts of the world or not, it is at all events suggestive to notice that the dates of their general appearance throughout the world, given by Mr. Walford in a recent paper to the Statistical Society, entitled, "Famines of the World, Past and Present," exhibit the same relation to the sun-spots as that noted by Dr. Hahn in the case of their visits to Europe.

The date of apparition, the locality visited, and the epoch of sun-spot minimum corresponding, are given below.

Date of Apparition.	Locality visited.	Epoch of Minimum Sun-Spot.
1802 ...	India	... 1798.3
1812-13 ...	"	... 1810.6
1833-35 ...	"	... 1833.9
1855 ...	United States	... 1856.0
1868 ...	"	... 1867.2
1874-77 ...	"	... 1877(?)
1878 ...	{ China, Spain, Algeria, } Bosnia, India	... 1877(?)

In the face of such an apparent predilection on the part of locusts to swarm during the minimum epoch of sun-spots, it might, I think, be advantageous to institute an extensive comparison of all past visitations of these insects with the eleven-year cycle of sun-spots. This after due allowance had been made for any known natural cycles of incubation, might possibly bring to light a physical cycle of visitation, the size and position of the area affected by which would, perhaps, afford some indication of the corresponding limits of the rainfall variation.

E. D. ARCHIBALD

11, Granby Terrace, Glasgow.

The Range of the Mammoth

THE criticism by Mr. Clement Reid of my paper recently read before the Geological Society, and not yet published, renders it necessary to remind him that his views as to the mammoth not being pre-glacial are not new, but were advanced by me ten years ago (*Pop. Science Review*, 1868, p. 275; *Geol. Mag.*, v. 7, July, 1868), and afterwards given up by the light of a wider experience. His arrangement of the complicated glacial deposits of Britain in one linear series, like all similar attempts, appears to me to be based on the fallacy that a difference in the character of the strata, in different areas, implies a difference in point of time. His divisions seem to me purely local, and mostly peculiar to the eastern counties. I see no reason for believing that, while five out of the six proposed were being accumulated east of the Pennine chain, there were no glacial phenomena in the west, in Lancashire or Cheshire, until the last phase, or the sixth of the eastern divisions; or, in other words, that the lower boulder clay of Lancashire and Cheshire is the equivalent of the last division. On the contrary, the marine sands and gravels covering the lower boulder clays, on both sides of the Pennine chain, and occupying a large area round Crewe, Stafford, and in the Trent Valley, is to me a well-marked horizon, defining the upper from the lower series of boulder clays. It is very likely that the lower boulder clay of Lancashire and Cheshire is the equivalent of the lower boulder clay series of Norfolk and Suffolk, as well as of the "moraine profonde" of Scotland. It must, however, be admitted that the correlation of the glacial deposits in various parts of Britain has not yet been satisfactorily made out. "Tot homines quot sententiae."

To group them, as they are frequently now grouped, in one linear series, seems to me almost as useless as to construct a history of Europe in which the dynasties ruling various kingdoms at the same time are described one after another, and taken to belong to different periods because they were different dynasties.

W. BOYD DAWKINS

Fossil Floras of the Arctic Regions

THE author of the valuable paper communicated in *NATURE*, vol. xix, p. 124, on "The Fossil Floras of the Arctic Regions," will find in an essay of mine, entitled "Thalassa," and published in the course of last year, a number of facts and arguments in corroboration of his views regarding the influence of oceanic currents upon climate. In this essay, which is mainly founded upon the observations made on board H.M.S. *Challenger*, I have endeavoured to show how a relatively trifling elevation or depression of the sea-coast or of the bed of the ocean may considerably alter the configuration of an oceanic basin; how such an alteration must affect the direction, volume and temperature of existing currents, and thus have a tendency to change the climate and ultimately the distribution of animal and plant life in the regions bordering on the oceanic basin. I also (p. 29-30) ventured to express the opinion that "it appears hardly necessary to go in search of vast cosmic changes, such as an alteration in the position of the terrestrial axis, a diminution in the amount of solar heat . . . while we have, close at hand, an agency whose effect upon climatic conditions may be said to be a matter of daily experience, and which is sufficiently powerful to establish, in almost any region on the earth's surface, the small difference of temperature which is a decree of life or of death to numerous animal and vegetable organisms." To this I may now add, that the influence of oceanic currents upon climate and upon the distribution of life will be most felt and produce the most remarkable results in the *Arctic* and *sub-Arctic* regions, which, as we know, may at one period be swept by powerful polar currents, at another invaded by vast masses of warm water brought there by currents from the tropical regions, such, for example, as the Gulf Stream.

The facts brought to light by recent sounding-operations regarding the configuration of the sea-bottom and the distribution of oceanic depths has led me to the conclusion that our continents and oceanic basins, such as they appear at the present day, are of immense antiquity; that changes in the distribution of land and water require for their accomplishment long periods, which, for all we know, may alternate with periods of repose or even of retrocession; and that, consequently, the influence of these changes upon currents and upon climate must be equally slow and uncertain in its duration. If, therefore, the effect of oceanic currents upon climate appears as an important factor, which can no longer be neglected in any discussion on the flora and fauna of past geological epochs, on the other hand, the slow and uncertain progress of the changes above mentioned seems to afford ample scope for the operation of other causes which, besides climate and temperature, determine the existence of certain species in a given area of the earth's surface.

J. J. WILD

The Microphone

TWO subjects of interest in connection with the practical application of the microphone have lately been brought to my notice by Raja Sir T. Madava Row, K.C.S.I., Dewan of Baroda. In the hope of securing a little assistance from some of your scientific readers I hasten to lay them before you.

The first question is with reference to the use of a microphone as a stethoscope. It seems that native ladies of high position decline altogether to allow a doctor to examine the chest in the ordinary manner. Sooner than submit to such an examination they would prefer to die—certainly rather a staggering fact for those imbued with European ideas. In the cause of humanity it is therefore desirable to do something for those whose position and caste would be imperilled by direct examination. If the microphone could be so delicately arranged as to transmit the auscultatory sounds, a medical ear, even at a distance, would surely be able to detect the existence of any disease of the heart or lungs. In the few experiments that we have made with our limited appliances we have been able to hear the ticking of a watch at a distance of about 200 yards, and the roar of a black ant when attacked by his companion, but as yet we have heard no internal sounds from the human breast. Perhaps with better devised instruments some one may have been able to obtain that which has yet been denied to us. I am sure many native ladies would be glad to get an affirmative answer to the question, "Can the microphone be used as a stethoscope?"

The second subject seems to me to be a much more difficult one to grapple with. Sir Madava Row writes to me as follows:—

"In the undulating region of Travancore, where the water-bearing strata heave and fall according to the locality concerned, I have come across a set of professional men who are generally consulted by those who wish to sink wells in view to ascertain whether, at a given spot, a well may be sunk with the probability of finding water *near enough*. These professional men undertake to predict where the springs will be found near, and where they will be found at great depth, and their predictions are generally verified with great accuracy. I took some trouble to ascertain how these men are enabled to predict the proximity, or otherwise, of the springs underground. Brushing aside the ceremonies and incantations they perform in view to deceive others and perhaps themselves also, I found that they detect the proximity of the subterranean springs by lying down on the bare ground in the dead silence of night, with the ear in contact with the ground, and trying to hear the sound of the flow of water in the strata beneath. By practice the ear is made very sensitive, and the degree of distinctness with which they hear the sound of flowing water enables them approximately to predict the depth of the springs. It is in this manner that appropriate spots are selected for sinking wells.

"Now, would any of the instruments you are experimenting with magnify the sound of the subterranean flow of water so as to greatly facilitate the process I have described? If so, it may be a considerable practical gain."

To this query I have hitherto been able to return no other answer than a negative one. Both the subjects are practical ones, and I only hope that there will be before long some light cast upon them.

THOS. S. TAIT

Baroda, India, November 4

'Leaf-Sheaths and the Growth of Plants

THE latest results of M. Bert's researches into the growth of plants (see *Comptes Rendus*, vol. 87, p. 695, November 4), have led me to publish an observation which I made on the inner sheaths of young leaves this last spring. The spring before last I was struck with the crimson-like colour of these silky sheaths on many trees, whereas the young leaves they cover are of a tender green, and it naturally occurred to me that their purpose was not only to form a wrapper to the leaf, but also a coloured screen, which would allow the red rays of the spectrum to pass, and to a certain extent quench the blue rays. But I could not understand why the latter rays should be cut off, since they are highly actinic, and the leaves themselves are green. Last spring I carefully noted the tints of the leaf-sheaths of different trees, with the following results:—

Name of Tree.	Tint of Inner Leaf Sheath.	Tint of Outer Leaf Sheath.
Elm	Red (crimson) ...	Reddish-brown.
Lime	Red (crimson) ...	Reddish-brown.
Beech	Red (crimson) ...	Brown.
Sycamore	Red (crimson).	
Ash	Sooty-black.
Horse-chestnut ...	Red (crimson).	
Maple	Bright-red.	
Birch	Brown.	
Oak	Brownish-red.	
The Bramble ...	Reddish.	
The Hawthorn ...	Red.	
Certain Roses ...	Red.	
Wild Cherry ...	Red.	

Sometimes the bark on the stem of young sycamore shoots and the top leaflets were tinged with a deep reddish-brown. The overlapping tips of young leaves in buds were frequently reddish, and the majority of outer leaf-cases were a warm or reddish-brown. The shining buds of the horse-chestnut afforded a fine example of the phenomenon. The leaf-cases were of a strong red, like carmine, the exposed tip of each sheath leaflet being dyed a deeper red at the middle, shading off to the edges, where they overlapped. Under this protective curtain was a layer of flossy fibre, like cotton, swathing the pale young leaves underneath.

The recent researches of M. Bert throw light on this interesting subject. He finds that plants kept under green glass shades soon perish, because these intercept the red or less refrangible rays of the spectrum, and allow the blue or more refrangible rays to pass. Red glass, on the contrary, sustains life, although it becomes enfeebled by reason of the withdrawal of all the blue

rays. M. Bert thinks that all the rays are necessary to the full vigour of the plant, and in the proportion of the solar spectrum; but it would appear from the care which nature has taken to redden the young leaf-cases, that for certain trees at least, the spring sunlight is richer in blue rays than she wishes, and therefore she has arranged that part of them shall be excluded, while all the red rays (or those which affect the maximum reduction of carbonic acid gas, and the building up of tissues) are allowed to pass into the leaf. I should add that this effect of colour is evidently superadded to the other functions of the sheath, as it usually appears as a more or less perfect colouring of the *outer surface* of the sheath only.

West Croydon

JOHN MUNRO

Hornets

THE following fact, which I have been enabled to verify concerning a hornet, may be interesting to some of the readers of NATURE:—In a letter I received from my grand-son, a very observing and accurate young naturalist, there was the following statement, dated October 13, 1878, Tunbridge Wells:—

"Last week I caught a splendid large hornet on the hall window, and last Saturday I caught a smaller one on a small oak-tree in Hurst Wood (Tunbridge Wells). He was engaged in eating some sticky, whitish stuff which had come out of the tree in several places where it had been cut or bruised. This stuff seemed to attract all the insects in the neighbourhood, especially swarms of flies. There were two red admirals (butterflies), two hornets, four wasps, and hundreds of bluebottles and other small flies, busily engaged in eating this substance, which was bored with small round holes. On Sunday, as we came home from Speldhurst Church, we passed the same tree, and on it, to my great surprise, I caught half a hornet, which was very active, running about the tree, and seemed to be quite happy and comfortable. He had no abdomen at all, except a small piece of the upper skin, which hung on; his left wings were very much battered, and he had lost his left hind leg." This half hornet was brought home and examined, keeping actively alive until the evening, when it was destroyed for the sake of preservation. I had an opportunity of examining the half hornet alluded to very soon after, and the facts detailed in the letter I have quoted were ascertained to be quite correct. This hornet was a small specimen, and I found all the abdomen gone except a small portion of the upper part of the first joint, which still remained attached to the thorax. The left wings were much broken, and one hind leg gone. In this disabled state, how long the hornet might have lived is a point which I regret was not ascertained.

Raystead, Worthing

WM. WILSON SAUNDERS

Equine Sagacity

A PLEASANT story has just come to us from the Cape of Good Hope. In Graaf-Reinet, as in all the old Dutch towns in the colony, there is, in the centre of the place, a large market square, where the farmers, traders, and others, arriving with their produce at any hour of the day or night, may "out-span" the oxen or horses from their waggon, send the cattle out to the "commonage" to feed, while they bivouac at their waggon, as is the wont of African travellers to do, until the eight o'clock morning market auction.

An old horse belonging to one of these parties had wandered about in search of grass and water—vainly, no doubt, for it was during the severe drought from which the country is but now recovering. Coming to the great bare market-place, and finding a knot of men talking there, he singled out one of them, and pulled him by the sleeve with his teeth. The man, thinking the horse might possibly bite, repulsed him, but as it was not very roughly done, he returned to the charge, with the same reception; but he was a persevering animal, and practically demonstrated the axiom that "perseverance gains the day," for upon his taking the chosen sleeve for the third time between his teeth, the owner awoke to the idea that a deed of kindness might be required of him; so, putting his hand upon the horse's neck, he said, "All right, old fellow; march on!" The horse at once led the way to a pump at the further side of the square. Some coloured servants were lounging about the spot. One of them, at the bidding of the white man, filled a bucket with water; three times was the bucket replenished and emptied before the "great thirst" was assuaged, and then the grateful brute almost spoke his thanks to his white friend by rubbing his

nose gently against his arm, after which he walked off with a great sigh of relief.

A story somewhat analogous to the foregoing was told me by a friend, whose uncle, an old country squire in one of our western counties, had a favourite hunter in a loose box in the stable. One warm summer day he was "athirst," and could get no water. He tried to draw the groom's attention to the fact, but without success. The horse was not to be discouraged; he evidently gave the matter consideration. The thirst was pressing. All at once he remembered that he always had a certain halter put upon his head when led to the water. He knew where it hung. He managed to unhook it from its peg, and carried it to the groom! who at once, in great admiration of the knowledgeable brute, rewarded him in the manner he desired.

M. CAREY-HOBSON

Colour-Blindness

DR. PRIOR's letter is almost entirely philological, and therefore does not come within my province. I have alluded to the colour-blind impression of white in my paper in the *Phil. Trans.* I should like to know more about the eyesight of the person who says he cannot distinguish snow.

The latter part of the first paragraph of my letter on p. 120 should run, "In pigments, neutral green appears to me gray."

December 14

W. POLE

Magnetic Storm, May 14, 1878

REFERRING to a letter from the Rev. S. J. Perry in *NATURE*, vol. xviii, p. 617, reporting the magnetic disturbances observed at Stonyhurst, Melbourne, and Shanghai, on May 14, it may interest your readers to learn that earth-current disturbances were also noted on the Persian Gulf cables from 4 P.M. (Kurrachee time) on the 15th up to 5 A.M. on the following day.

Unusually strong earth-currents were also observed on June 3 and 4, on the cables between Bushire and Kurrachee; the current-strength at 2.40 P.M. on the 3rd, and 12.20 A.M. on the 4th, being reported as equal to fourteen Daniell's cells.

Kurrachee, November 8

HENRY C. MANCE

"Measuring the Height of Clouds"

THE electric light promising to be of great intensity at a small cost, the thought occurred to me that it might be used with advantage for the purpose of ascertaining the height of clouds. For, supposing an electric lamp sending a beam of light to the clouds, the spot where the light meets the latter, will be more or less visible, and we are obviously able to determine trigonometrically the height of the cloud.

By using two lamps, or a lamp and two reflectors, we may easily find also the rate at which clouds travel, by bringing the plane, passing through the axes of the beams of light, parallel to the direction in which the clouds move, and by noting the time it takes a cloud to travel from one beam of light to the other, having, of course, determined also the actual distance between the two spots of light on the clouds.

The above refers to observations during the night only, but by making use of coloured light, or by bringing a substance in the carbons of the lamp, the spectrum of which is easily recognisable, we might probably be able to work also during day-time.

Kew

J. F. WILKE

The Weather

AFTER a week of unusually cold weather, the mean temperature having been 28°·5, and the wind constant from a northerly point, a thaw set in yesterday, and the wind became westerly, when immediately after sunset a rather unusual condition of weather occurred: viz., the rapid formation of a complete sheet of ice on the roads, though at the time, and till eleven P.M., the thermometer was 2° or 3° above the freezing-point.

As the sky was overcast at the time radiation cannot well account for it. Owing to the penetration of the cold, the surface must have retained a temperature considerably below 32° for some time after the air had become warmer and damper, so that the moisture was at once congealed.

Clifton, December 16

G. S. THOMSON

THE LAST EXPERIMENTS WITH THE 80-TON GUN

THE last experiments with the 80-ton gun at Woolwich deserve to be recorded, if only for the sake of showing that our scientific artillerists appear to be working in the proper channel. The last shot fired from the monster piece of ordnance was with the unprecedented charge of 460 lbs. of powder, and yet there was not so much strain upon the gun as that formerly exerted by charges one hundred lbs. less. The reason of this is in the main due to a change having been made in the character of the gunpowder employed; for whenever the former powder was used, even in lesser quantity, the pressure of the gas inside the gun rose at once. This would not so much matter if it could be shown that with the increase of strain, the work of the shot increased also. But such is not the case. For instance, in the case of two shots fired last week, one was sent on its way by 460 lbs. of prismatic powder, recording a velocity, we are told, of 1,626 per second, and a strain inside the gun of 19½ tons, while the other, with but 425 lbs. of cube powder, had a speed of only 1,600 feet, while it exerted a strain upon the weapon of 21 tons per square inch. The gun has been chambered—or in other words the cartridge cavity enlarged—to permit the introduction of heavier charges, as also to allow of a certain amount of air-space in the cartridge; but this modification in the weapon, beneficial as it may be, does not account, as we have shown, for the decrease upon the strain of the gun. This is due to the change in the powder.

In most of the former experiments a gunpowder of solid cubes, irregular in shape and measuring about an inch and a half, were employed; the recent results have been secured by thick six-sided prisms, about an inch across, and so accurately shaped that they may be packed together very closely. There is a single perforation in the middle of this prismatic powder, which, by the way, is of German origin, and when the cartridge has been securely packed so as to represent one solid mass, the perforations running through the whole length of the charge permit of the same being rapidly kindled. If the perforations were not there, half the charge would probably be expelled the gun before it was kindled; so that a packed cartridge of prismatic powder represents as nearly as possible a solid charge with tubes running its entire length, through which the kindling flames pass.

It has, of late, grown to be an axiom that the larger the gun the larger must be the grains of powder. A large grain of gunpowder burns slow because the fire is some time reaching the centre, and a slow-burning powder is what artillerists require for rifled guns. In a smooth-bore weapon the cannon ball fits loosely, and may be expelled at a bound; but in rifled cannon the shot, so to speak, moves upon a sort of railway, and it would never do to get the shot into motion too suddenly. An undue strain would be exerted upon the gun, while the velocity of the shot would not be increased. For a rifled gun, therefore, a slow-burning charge is absolutely necessary, and this is to be secured only by reducing the surface to be kindled. In the case of the prismatic powder, the grains, if they may be called by that name, are so closely packed that no fire can get between them, and hence the action of kindling is still further reduced.

Not only is the shape and density of powder grains now attracting particular attention, but the percentage of moisture contained in the material has also lately been under study. The amount of water in gunpowder to the minute extent existing in ordinary samples is found to influence combustion in a very marked degree, and nothing but an exhaustive series of trials can give sufficient data for practical application of so important an element in the science of explosives. In the meantime chemists are pointing out yet another source of uncertainty in the combustion of gunpowder, to which, notwithstanding

their repeated warnings, but little attention has hitherto been given. We mean the composition of the charcoal. According to the manner of preparing this, the method adopted for charring and the material employed, so does the chemical composition of the charcoal differ. Some samples, for instance, prove on analysis to contain 85 per cent. of carbon, while others have 20 per cent. less; it is scarcely to be expected that gunpowder made from the two kinds will have the same burning qualities, and yet with gunpowder manufactures charcoal is charcoal, no matter how much its component parts of carbon, hydrogen, oxygen, and ash may differ. It is of little use, therefore, paying any particular attention to the physical qualities of gunpowder so long as its chemical composition is almost entirely ignored.

The manner in which the strain upon the gun and the velocity of the shot are measured at Woolwich are worthy of explanation. The means employed are of the simplest kind. The maximum pressure of the gases inside the gun as the shot is being expelled is recorded by what is termed a "crusher gauge." This is no more than a tiny pillar of copper. The pillar is placed loosely in a tube, the end of which, made of steel, stands firm and fast no matter what the pressure. So that the soft copper pillar, when subjected to the action of the gas, gets compressed, or crushed, and assumes something of a barrel shape. The pillar and its case, being affixed to the base of the shot, gets the full pressure of the gunpowder gases, and its length afterwards denotes how much this pressure has been. To secure more trustworthy pillars of the metal it is the practice to compress them first of all to a certain degree, to remove any honeycomb or imperfection, and, thus uniformly compressed, they may be relied upon to record the strain with accuracy. Comparison of the fired pillar, with other pillars which have been subjected to known pressures, at once reveals the degree of force to which the former has been subjected in the gun. The maximum pressure, or strain, to which the 80-ton gun should be subjected, is set down as 25 tons on the square inch, and it is with the aid of this "crusher-gauge" that the strain exerted in the various experiments has been ascertained.

The initial velocity of a shot, or, in other words, the rapidity with which a projectile flies at the outset of its career, is now measured by an electrical instrument, the invention of Major le Boulengé, a Belgian officer. As in the case of other instruments of a like nature, the shot is made to break through two wire screens, placed at some distance from one another. The interval is usually about 100 feet. The screen is simply a wooden framework with fine wires zigzagging across, and it is these fine wires which the shot cuts. One screen is near the muzzle of the gun, and the other at the distance we have mentioned. No. 1 screen is in connection with an electro-magnet in the instrument-house, and No. 2 screen with a second, the two magnets hanging close together. While the wires in front of the screen are perfect, an electric current passes without interruption, and the electro-magnets in connection with them are endowed with power, but this power ceases as soon as the shot cuts the wires of the screen. Before the gun is fired there is suspended to the magnets two rods of iron, which remain, however, only so long as the magnets are magnets. When the shot is fired, No. 1 screen is torn, and down falls the rod suspended to No. 1 magnet; an instant afterwards, when the shot has reached No. 2 screen, No. 2 magnet also loses its virtue, and down falls the second rod. The time between the falling of the two rods is so small, that ere the first has fallen half its length the second has dropped upon a trigger, which trigger darts out and strikes the side of No. 1 rod. When the latter is picked up, the first thing is to examine the surface for the mark of the trigger, for the position of this mark, whether high or low, tells the operator what he wants to know. The rod

being of a given weight, always takes the same time to fall, and according whether it has fallen half or quarter its length, so the time taken by the shot to travel between the screens has been long or short. In a word, the rod has only to be compared with a prepared scale in order to read off the number of feet per second at which the shot has gone on its way.

THE REGISTRARSHIP OF LONDON UNIVERSITY

LAST week we referred to Dr. Carpenter's intended resignation of the Registrarship of the University of London. We have before us his letter intimating his desire to resign his post on May 31 next, and the resolution of the Senate in connection therewith. By the date mentioned Dr. Carpenter will have completed his twenty-third year as Registrar, and, including his previous nine years as Examiner, his connection with the University has extended over four-fifths of its term of existence, and over a corresponding proportion of his own professional life. There is no doubt that the success of this great institution is to a great extent owing to the energy and faithfulness with which Dr. Carpenter has discharged the duties of his post. It has been fortunate for the University as well as for science that a man of so eminent a scientific position has been so long and so intimately connected with it, and it will be extremely difficult to find one capable of taking up adequately Dr. Carpenter's work. We have pleasure in publishing the resolution of the Senate, to which we have referred.

"In accepting the Registrar's resignation of the important office he has held since 1856, the Senate desire to record their sense not only of the ability, judgment, and fidelity with which he has uniformly discharged its duties, but also of the zeal and efficiency with which he has on all occasions exerted himself both within and beyond the limits of his official obligation, for the promotion of the best interests of the University.

"The Senate would further record their conviction that it has been of special advantage to the University, during the twenty years of its most rapid development, to have had the services of a Registrar who, besides being an excellent administrator of its affairs, has attained, by his scientific labours, a position which has given him a just weight and influence over those with whom he has been brought officially into contact.

"The Senate strongly recommend the Registrar to the favourable consideration of the Lords of Her Majesty's Treasury as having acquired, by 'special services,' a claim to a larger superannuation allowance than that to which he is entitled by mere length of service."

ABOUT FISHES' HEADS

IN a former number (vol. xvii., p. 286), in a note "About Fishes' Tails," we called attention to some recent observations of Alexander Agassiz on the young stages of some fishes, in which he showed the wonderful changes that, as development went on, took place in their caudal fins; yet strange though these changes are, they seem as nothing to those that take place in some fishes' heads, and the facts first noticed by Steenstrup, and the theory which, by a marvellous power of intuition, he built up thereon, as to the eye in a flounder passing from the right side of its head to its left, have been in a great measure confirmed, and perhaps in a greater measure added to, by the painstaking observations quite recently published, of Alexander Agassiz,¹ from which it would now seem very certain that even the most shapeless adult fishes begin their life as quite symmetrical young creatures. No more

¹ *Proceedings of the American Academy of Arts and Sciences*, vol. xiv., July, 1878.

unsymmetrical fish can probably be found than an adult flounder with its unsymmetrical tail, with its twisted head, with its two goggle eyes—brought together on the one side of that head—and yet examine a flounder while yet young. "The one I captured," writes Agassiz, "was so transparent as to rival the most watery of jelly fishes. When placed on a flat glass dish it could only be distinguished by allowing the light to strike it in certain directions, otherwise all that was visible were the two apparently disembodied bright emerald eyes moving more or less actively. It was over an inch in length, the position of the eyes was perfectly symmetrical, and they were placed at a considerable distance from the anterior extremity of the snout; the dorsal fin extended almost to the nostrils." From this beautiful symmetry how then did the strange want of it in the adult fish arise? Long ago (1863) this question presented itself to Steenstrup. He had a small number of very young flounders preserved in alcohol, and from an examination of these he answered the query thus:—The young flounder, after a short time, takes to lying on its right side, why no one can tell, but with this result that the eye of that side begins to turn inwards, and passing through the tissues of the head, transfers itself to the left side. So strange seemed this explanation, that Malm's observations, in which he seemed to show that this apparent transference was really due to a torsion or twisting of the entire head, appeared to some to be, perhaps, the most probable explanation of the extraordinary phenomenon described by Steenstrup, and yet in Steenstrup's paper he very clearly showed that any ordinary torsion of the head of a flounder on its axis was wholly insufficient to explain the final position of its eyes. Since 1863 a good deal has been written upon the subject of the want of symmetry in the heads of the so-called flat fishes, more especially by Sir Wyville Thomson, Dr. Ramsay Traquair, Dr. Schiodte, Dr. Klein, Professors Reichert and Canestrini; but the most important and the latest memoir is the one just published by A. Agassiz, which forms a second part of his memoir, "On the Young Stages of Osseous Fishes," and is devoted chiefly to the development of the flounders. This memoir is accompanied by eight excellent plates, some of which show very well the changes of form through which some of the young flounders pass. The young flounders of some species attain a considerable size ere they show the least tendency to favour one side more than another, and before there is any change in the position of the eyes. They then swim vertically, at least when they come up to the surface to feed. This they will do on bright sunny days, about ten o'clock in the morning, while the water is very smooth, and they will then be seen to devour greedily swarms of embryo crustaceans of all orders. Some will after a while settle down on their left sides, which then in time become colourless and blind, these would be called dextral, while in some just the reverse takes place; but no matter on which side they take to resting on, the exchange is the same. First there is a slight advance of the eye of the blind side towards the snout, then this rises higher and higher towards the medial line of the head; it now becomes more and more visible from the coloured side, until at last it quite passes over. This transfer commences, in eight species observed by Agassiz, very early in life, while all the face-bones of the skull are quite cartilaginous, and, by a combined process of rotation and translation, it is completed long before these have become ossified. So far these observations of A. Agassiz were completely in conformity with the observations of Malm, who, it will be remembered, did not trace the changes undergone during the process; and they seemed to be completely antagonistic to the idea of Steenstrup, that the eye from the blind side passed through the tissues of the head and came out on the coloured side. But in the late summer of 1875 a little shoal of some fifteen quite transparent flounders were captured by Agassiz,

on a quiet and brilliant morning, on the surface of the water at the mouth of the harbour of Newport. They were swimming vertically, and violently rushing after the minute entomostraca which swarmed on the surface. They were at once transferred to shallow glass jars, in which they would remain at the bottom on their right sides, for hours immovable. When disturbed they were rapid in their movements, frequently jumping out of the water. When swimming vertically they usually moved obliquely, the tail being carried lower than the head. When one of these was looked at in profile, its right eye could be seen through the head, slightly in advance and a little above the left eye; owing to the great transparency of the body, the right eye was then nearly as useful as if placed on the left side. Gradually it rose, until in about six days it was well above the left eye; shortly after, wonderful to relate, it was seen to sink into the tissues at the base of the dorsal fin between this and the frontal; slowly it sank until the huge orbit became reduced to a mere circular opening. Little by little this became smaller and smaller, the eye pushed its way deeper into the tissues, until an additional opening was formed on the left side. At this stage there were three orbital openings, though of course but two eyes. The original or right-orbital opening soon became closed and the coloured side had its two eyes. Thus was the suggestion of Steenstrup proved to be correct by careful observation on a living form, and what is of even greater interest, A. Agassiz is, from having thus, as it were, seen all round the subject, enabled to suggest that the difference between these two methods of the transference of these eyes is not so great as would at first appear, the eye that sinks through the tissues, only taking a slightly shorter cut to arrive at its destination than the one that travels round the frontal bone. He is also able to hint at facts and suggest thoughts thereon, that seem to us to be as full of interest as of novelty. Only a few of these can we allude to, such as the great length of the optic nerve, which allows slack to be taken during the transfer of the eye, and yet does not cause the sight to be interfered with, and the direct and very active circulation taking place to and from the heart and the orbital cavity, constituting almost an ocular heart.

The causes usually assigned for the development of fishes with a binocular side are all more or less unsatisfactory. It is known that in experiments thereon similar conditions constantly fail to produce similar results. Of the causes assigned the chief are: that the great width of the body in flounders makes the resting on the one side the most natural position; but there are many fishes of far greater width which swim vertically. The absence of a swimming bladder has also been assigned as a good reason, but some flounders have a swim bladder. Alexander Agassiz hints that the true cause may perhaps be that some broad fish may find it much easier to pursue their prey while swimming close to the bottom. They are protected from detection by their coloured side resembling sand, mud, and gravel. This would gradually lead to the exclusive use of one side (should the fish lie on either side) and would result in the atrophy of the eye, unless the fish were able to transfer his eye to the other side and so retain it. But then it will be asked, why do we not find flat fish among the broad forms of every family of fishes? and, remembering that flounders are only found in the most recent geological deposits, why were they not as common in earlier times as at the present day? and, above all, why was the tendency of the eye to change transmitted from generation to generation and not the binocular state itself?

May not, suggests Agassiz, Giard's idea come to our help here. Giard hints that the fundamental cause of all asymmetry in the animal kingdom is due to a difference in the strength of the organs of sense, and he gives in support of this idea some most ingeniously explained

cases. At any rate, the action of light upon the sense organs, which in all embryos are developed out of all proportion to their ultimate conditions, must remain an all-important element in its effect upon the nervous system. In embryos so transparent as those of many young fishes are, which might be said to be nothing but eyes, brain, and notochord, the action of light must be infinitely more potent upon their nervous system than it can possibly be in older stages, when the muscular system has assumed the control.

The pigment cells appear early in the egg. In some fishes, immediately before the little fish is hatched, two colour elements are to be found, black and yellow; but in the majority of cases the black alone is present, the yellow element appearing subsequently, and, last of all, the red. Pouchet's experiments seem to show that the blue pigments are only a dimorphic condition of the red pigments. This, by the way, would account for why a lobster turns red when cooked. The proper mixture of the three colours—black, red, yellow—enables the flounders to imitate most admirably the general effect of their feeding-grounds; so much so that often it requires a most practised eye to detect them. The rapidity with which they can change their colour is also quite striking. Agassiz frequently removed a jar containing a young flounder, which he figures, from a surface imitating a sandy bottom to one of a dark chocolate colour, and in less than ten minutes the black pigments would obtain a preponderance.

The question of the form and development of the pigment cells is also discussed in the memoir. As to the causes of colour in the animal kingdom we would seem to be only on the threshold of an interesting and novel field of inquiry, and it would seem, says Agassiz, very hazardous to infer from a physiological point of view, as has been frequently done on philological grounds, that Homer's colour descriptions indicate a gradual development of the sense of colour in the early races of mankind.

E. PERCEVAL WRIGHT

Since writing the above we have received from Prof. Japetus Steenstrup "Fortsatte Bidrag til en rigtig Opfattelse af Oiestillingen hos Flyndrene," with four plates. This supplemental memoir is in Swedish, and gives a *résumé* of what has been written on the subject since the paper in which the illustrious author first called attention to it, with criticisms thereon. An advance sheet of Agassiz's paper also enabled him to quote the chief details of his observations. The memoir also contains a description with beautiful figures of a *Plagusia* form, which was captured while its eye was just about to traverse the head obliquely and to take its place on the other side as the upper eye. It also gives a series of figures which make clear the connection that exists between certain frequently met with monstrous forms of flat-fish and the normal forms. One of these thus illustrated is the "malformed brill" figured in Yarrell's "British Fishes."

THE BROWN INSTITUTION

IT is now just seven years since the Brown Institution was opened, under the auspices of the Senate of the University of London, as a place for the study of the diseases of animals. It was at that time placed by the Senate under the direction of a committee comprising the most eminent members of the medical profession, with Dr. Sharpey as their chairman. Dr. Burdon-Sanderson was appointed superintendent, with Dr. Klein—who had then recently migrated from Vienna to London—as his coadjutor. A hospital had been built for the reception of diseased animals, and placed under the care of a highly qualified veterinarian, Mr. Duguid, and in connection with it a good and sufficient laboratory had been erected

for the purpose of carrying out pathological and therapeutical experiments. No provision could be made from the funds of the Institution for the expenses of such investigations, it having been found necessary to devote the whole available income to the purely charitable purposes which the founder had associated with the investigation of disease in his testamentary statement of the objects he had in view. Pecuniary aid for research was, however, not wanting. The work done in the laboratory was, during the first three or four years, for the most part conducted at the instance of Mr. Simon, who was at that time at the head of the Medical Department of the Privy Council, and it was thus provided for by annual grants of public money. For a time all went on favourably, and it seemed possible that the Brown Institution would eventually fulfil the functions and acquire the importance of those State-supported establishments for research which have recently accomplished so much for the advancement of medical science in Germany. But, alas! clouds soon began to gather. That strange, popular agitation which culminated in the passing of the "Vivisection Act" showed itself to be specially hostile to those systematic experimental investigations which, at the present moment, are absolutely necessary for the elucidation of fundamental questions in pathology. Accordingly, the Brown Institution became a prominent object of attack. When the Act was passed it became apparent that the realisation of the hopes which had been entertained was no longer probable, for it was soon found that, in their bearing on pathological inquiries, the restrictions imposed really amounted to prohibitions.

These circumstances affected the working of the institution in such a way as seriously to diminish its prospect of usefulness. Early in the present year Dr. Burdon-Sanderson, baffled in his plans, resigned his appointment. His resignation has been followed by that of Mr. Duguid who has accepted a more lucrative position under Government; and finally Dr. Klein, who became a candidate for the vacant superintendentship, and was supported by the unanimous recommendation of the Committee, but was rejected by the Senate of the University, who thus showed that the possession of an academical title confers none of the academical spirit. At the present moment, therefore, the Brown Institution is represented only by the buildings and the endowment. The men who have done its work, and whose names have been hitherto identified with it, have retired. The prospect is discouraging, but not quite so bad as it seems.

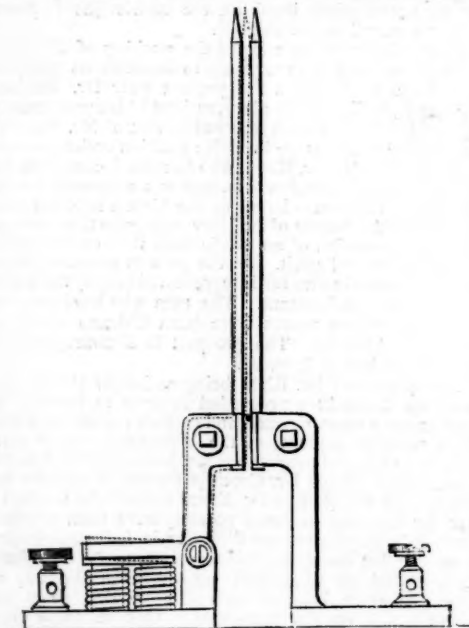
The services of Dr. Klein being no longer at their disposal, the Committee proceeded at once to invite other candidates to come forward, and on their recommendation a distinguished graduate of the University, and an energetic and able pathologist, has just been appointed to the vacant office. From Dr. Greenfield's antecedents we feel sure that he will (failing Dr. Klein) prove to be as good a man for the post as could possibly have been selected. Nor will he experience any difficulty in finding sufficient scope for his energies. Whatever obstacles may have been placed by ill-advised legislation in the way of some important lines of scientific inquiry, there are others which remain accessible. One of these lines was opened by Dr. Burdon-Sanderson three years ago. In the beginning of 1876 a grant of 500*l.* was made by the Royal Agricultural Society for the carrying out of scientific investigations at the Brown Institution, as to the nature and origin of some of the destructive contagious diseases of animals which prevail in this country. The results of these inquiries have already been, in part, printed, and others are in course of publication. In consequence of the resignation of Dr. Sanderson and of his veterinary coadjutor Mr. Duguid, the progress of his work has been temporarily arrested. But it is gratifying to be able to state that at the Annual Meeting of the Royal Agricultural Society which took place on

the 12th inst., an additional sum of 250*l.* was voted for their prosecution, and that they will be actively resumed as soon as Dr. Greenfield has completed his arrangements.

The interval of inactivity has been used by the committee for carrying out important improvements of the premises in Wandsworth Road, so that Dr. Greenfield will enter on his new duties with many advantages in his favour—an excellent laboratory, sufficient resources, fruitful work already in progress, and a committee including such men as Busk, Gull, Paget, Quain, Sharpey, and Simon to back him. We feel confident that the wisdom of the appointment will be justified by the result, and that the new chapter in the history of the Brown Institution which will begin with the year 1879, will be a successful one.

ON SOME IMPROVED METHODS OF PRODUCING AND REGULATING ELECTRIC LIGHT¹

IN a former communication to the Society I directed attention to the fact that when the electric light is produced from the ends of two carbon pencils placed parallel to each other, if the strength of the electric current, the thickness of the carbons, and the distance between them are rightly proportioned, the carbons will burn steadily downwards until they are wholly consumed, without any insulating material between them. To initiate the light by this method, it is necessary to complete



the electric circuit between the carbons by means of some conducting substance, which volatilises on the passage of the current, and establishes the electric arc between the points.

When a number of such lights are produced simultaneously from the same source of electricity, any interruption in the continuity of the current extinguishes all the lights in the same circuit, and each pair of carbons requires to be reprimed before the lights can again be established. This defect, as will be obvious, would cause

great inconvenience when the lights are not easily accessible, or are at considerable distances apart.

In the course of my experiments it was observed that when the electric circuit was completed at the bottom of a pair of carbons close to the holders, the arc immediately ascended to the points, where it remained so long as the current was transmitted. My first impression of this peculiar action of the arc was, that it was due to the ascending current of hot air by which it was surrounded. This, however, was found not to be the cause, as the arc travelled towards the points [in whatever position the carbons were placed, whether horizontally or vertically in an inverted position. Moreover, when a pair of carbons were held in the middle by the holders, the arc travelled upwards or downwards towards the points, according as the circuit was established above or below the holders. The action was, in fact, recognised to be the same as that which determines the propagation of an electric current through two rectilinear and parallel conductors submerged in contact with the terrestrial bed, which was described by me in the *Philosophical Magazine*, August, 1868.

In all the arrangements in general use for regulating the electric light, the carbon pencils are placed in the same straight line, and end to end. When the light is required, the ends are brought into momentary contact, and are then separated a short distance to enable the arc to form between them. The peculiar behaviour of the electric arc when the carbons are placed parallel to each other, suggested to me the means of lighting the carbons automatically, notwithstanding the fact that they could only be made to approach each other by a motion laterally, and to come into contact at their adjacent sides. To accomplish this object, one of the carbon holders is articulated or hinged to a small base plate of cast iron, which is so constructed as to become an electro-magnet when coiled with a few turns of insulated wire. The carbon holder is made in the form of a right-angled lever, to the short horizontal limb of which is fixed an armature placed over the poles of the electro-magnet. When the movable and fixed carbon holders are brought into juxtaposition, and the carbons inserted in them, the upper parts of the two carbons are always in contact when no current is transmitted through them, as shown by the dotted lines in the engraving.

The contact between the carbons is maintained by means of an antagonistic spring inserted in a recess in one of the poles of the electro-magnet, and reacting on the under side of the armature. One extremity of the coil of the electro-magnet is in metallic connection with the base of the carbon holder, while the other extremity of the coil is in connection with the terminal screw at the base of the instrument from which it is insulated. The coils of the electro-magnet are thus placed in the same circuit as the carbon pencils.

When the alternating current from an electro-magnetic induction machine is transmitted through the carbons, the electro-magnet attracts the armature and separates the upper ends of the carbons, which brings them into their normal position, and the light is immediately produced. When the circuit is interrupted, the armature is released; the upper ends of the carbons come into contact, and the light is produced as before. When several pairs of carbons are placed in the same circuit, they are, by this arrangement, lighted simultaneously.

H. WILDE

INFLUENCE OF THE STRAITS OF DOVER ON THE TIDES OF THE BRITISH CHANNEL AND THE NORTH SEA¹

THE conclusions are:—

1. The rise and fall of the water-surface and the tidal streams throughout the North Sea north of the

¹ Supplement to Paper read by Mr. H. Wilde at the Manchester Literary and Philosophical Society, November 26 (see *NATURE*, vol. xix. p. 78). Communicated by the Author.

² Abstract of a paper read at the Dublin meeting of the British Association.

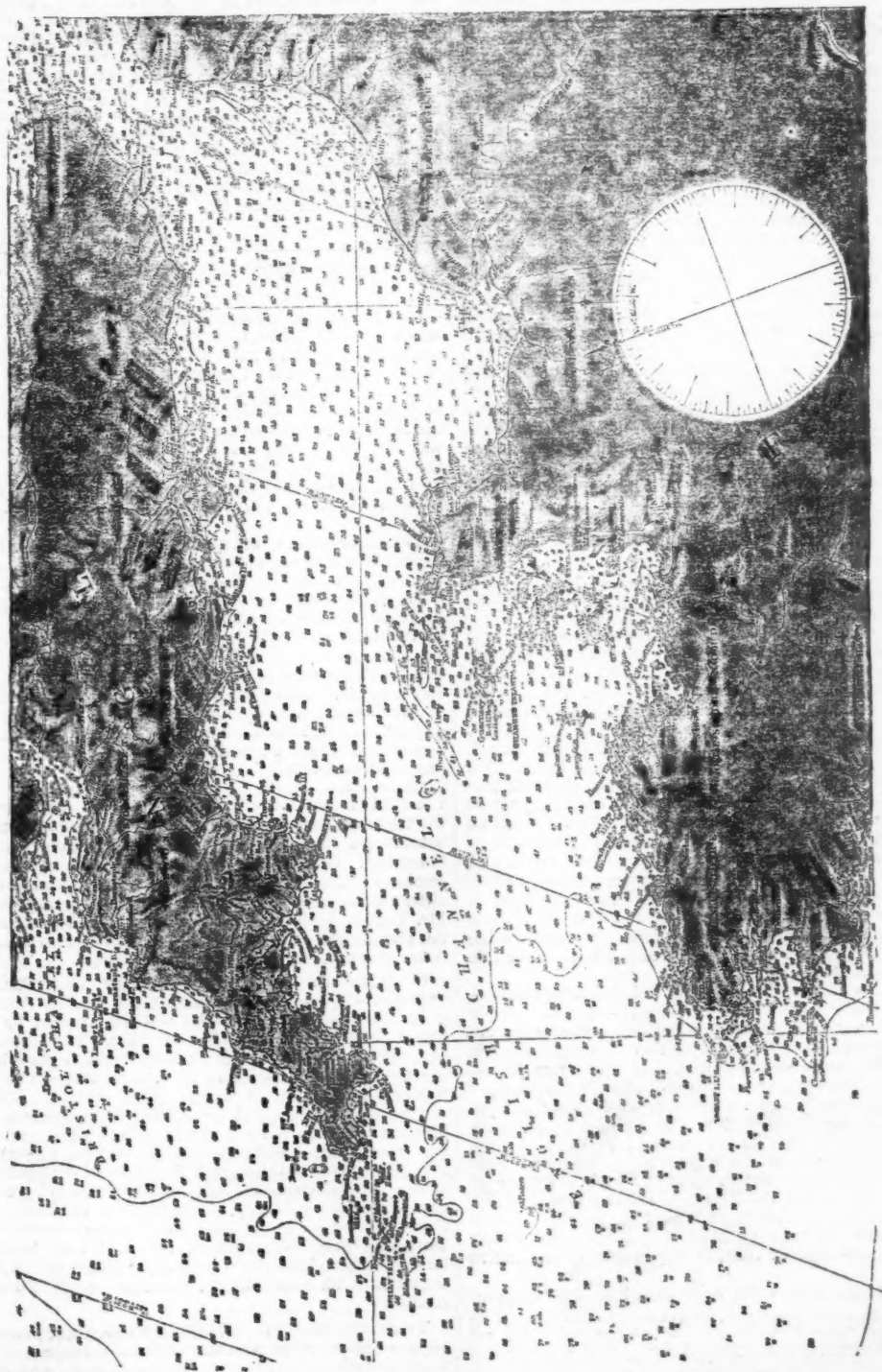


CHART OF THE ENGLISH CHANNEL.

parallel of 53° (through Cromer, in Norfolk) and the north coast of Holland and Hanover, are not sensibly different from what they would be if the passage through the Straits of Dover were stopped by a barrier.

2. The main features of the tides (rise and fall and tidal streams) throughout the British Channel west of Beachy Head and St. Valéry-en-Caux do not differ much from what they would be if the passage through the Straits were stopped by a barrier between Dover and Cape Grisnez (Calais).

3. A partial effect of the actual current through the Straits is to make the tides throughout the Channel west of a line from Hastings to the mouth of the Somme more nearly agree with what they would be were there a barrier along this line than what they would be if there were a barrier between Dover and Cape Grisnez.

4. The chief obviously noticeable effect of the openness of the Straits of Dover on tides west of Beachy Head is that the rise and fall on the coast between Christchurch and Portland is not much smaller than it is.

5. The fact that the tidal currents to the westward commence generally an hour or two before Dover high-water and to the eastward an hour or two before Dover low-water instead of exactly at the times of Dover high- and low-water, is also partially due to the openness of the Straits of Dover.

6. The facts referred to in Nos. 4 and 5 are wholly due to three causes:—

(1) The openness of the Straits of Dover.

(2) Fluid friction (in eddies along the bottom and in tide-races).

(3) Want of absolute simultaneity in the time of high-water across the mouth of the Channel from Land's End to Ushant.

It is certain that (1) is very sensibly influential; it is probable that (2) is also so; it is possible, but scarcely probable, that (3) is so. Without farther investigation it would be in vain to attempt to estimate the proportionate contributions of the three causes to the whole effect.

7. It is certain that were the Straits of Dover barred, and were the water frictionless, there would be nearly a perfect nodal line [with but a small deviation from perfect nodality because of the influence of cause (3)] across the Channel from somewhere near St. Alban's Head on the English coast to somewhere near Cape La Hague or Cherbourg or Cape Barfleur, on the French coast, that west of this line the time of low-water, and east of this line the time of high-water, would be exactly the same as the time of high-water at Dover; and that throughout the Channel the water would be flowing eastwards while the tide is rising at Dover, and westwards while the tide is falling at Dover.

8. (Understanding from Fourier's elementary principles of harmonic analysis that all deviations from regular simple harmonic rise and fall of the tide within twelve hours are to be represented by the superposition of simple harmonic oscillations in six-hours period, and four-hours period, and three-hours period, and so on—like the "overtones" which give the peculiar characters to different musical sounds of the same pitch.) The six-hourly oscillation which gives the double low-water at Portland and the protracted duration of the high-water at Havre¹ is probably in part due to the complex-harmonic character of the current through the Straits of Dover; that is to say, definitely, to a six-hourly periodic term in the Fourier-series representing the quantity of water passing through the Straits per unit of time, at any instant of the twelve hours.

The double high-water experienced at Southampton,

¹ At Havre, on the French coast, the high-water remains stationary for one hour, with a rise and fall of three or four inches for another hour, and only rises and falls thirteen inches for the space of three hours; this long period of nearly slack water is very valuable to the traffic of the port, and allows from fifteen to sixteen vessels to enter or leave the docks on the same tide.

and in the Solent, and at Christchurch and Poole, and still further west, generally attributed to the doubleness of the influence experienced from the tidal streams on the two sides of the Isle of Wight, seems to have a continuity of cause with the double low-water at Portland, which is certainly allied to the protracted high-water of Havre—a phenomenon quite beyond reach of the Solent's influence. It is probable, therefore, that the double high-water in the Solent and at Christchurch and Poole is influenced sensibly by the current through the Straits of Dover, even though the common explanation attributing them to the Isle of Wight be in the main correct.

WILLIAM THOMSON

OUR ASTRONOMICAL COLUMN

OCCULTATIONS OF STARS BY JUPITER'S SATELLITES. —Mr. Tebbutt, of Windsor, N.S.W., writes to the *Astronomische Nachrichten*, that on October 5 he made "an observation, which, if not without a parallel in the annals of astronomy, is at least an extremely rare one." A star of the ninth magnitude was occulted by the first satellite of Jupiter, under sufficiently good definition to allow of the latter being seen with a round disk: the occultation was not quite central, the star appearing to pass behind the northern portion of the disk. From the approximate position assigned to the star by Mr. Tebbutt, it must have been No. 20236 of Oeltzen's Argelander, called 9'10 mag.

The observation is not quite without a parallel, though doubtless a rare one; Flaugergues of Viviers (who, by the way, was the first discoverer of the great comet of 1811, as Mr. Tebbutt was also discoverer of the grand comet of 1861) observed an occultation of a small star by the third satellite of Jupiter on the morning of August 14, 1821, as described in a letter to Baron de Zach, which will be found in his *Correspondance Astronomique*, vol. v. p. 456. Flaugergues had proceeded to his observatory to watch an eclipse of the satellite, and on looking at Jupiter he remarked a small star near it; the satellite approached the star, and at 1h. 47m. sidereal time, appeared to touch it; at 1h. 56m. 52s. the star was no longer visible; at 1h. 59m. 10s. the satellite in its turn vanished in the shadow of the planet. He continued at the telescope some time after its disappearance, hoping to witness the star's emergence, but twilight soon became too strong. Perhaps now that the phenomena of Jupiter's satellites are more closely watched than formerly, such observations may become somewhat less exceptional; Mr. Tebbutt is doing good service in the observation of the phenomena of the Jovian system, as is also another Australian observer, Mr. Todd, at Adelaide.

OCCULTATION OF 64 AQUARI BY THE PLANET JUPITER.—It appears certain that the star 64 Aquarii, generally rated $6\frac{1}{2}$ magnitude, will be occulted by the planet Jupiter on September 14, 1879. The apparent place of the star for that day, taking its mean place from the Greenwich catalogue of 1864, with Mädler's proper motion, will be in R.A. 22h. 32m. 58.45s., N.P.D. $100^\circ 39' 0''.6$, whence, with the position of Jupiter from Leverrier's tables, as given in the *Nautical Almanac*, the apparent conjunction will take place at 1h. 53m. Greenwich mean time, when the geocentric difference of declination is $9''.8$. The polar semi-diameter of the planet is $23''.0$ and its horizontal parallax $2''.2$. It is clear, therefore, that there must be an occultation. The phenomenon will be most favourably witnessed at the Australian observatories; at Melbourne, for instance, the planet will be only a quarter of an hour from the meridian and 27° from the zenith.

THE CONJUNCTION OF MARS AND SATURN, JUNE 30, 1879.—The *Nautical Almanac* notifies a conjunction of these planets on June 30, 1879, at 8h. G.M.T., with Mars only $1'$ to the north of Saturn. It is not without interest

to examine this near approach more closely, particularly as Bouvard's Tables of Saturn were used for 1879. According to Leverrier's Tables, the position of Saturn from Bouvard requires corrections of about $+179s$. in Right Ascension, and $-0^{\circ}.4$ in Declination; whence, with Leverrier's place of Mars the conjunction in right ascension occurs at 8h. 37m. G.M.T., and at this time the geocentric difference of declination is $1^{\circ} 29' 0''$. The apparent semi-diameter of Mars (taking $9''.45$ for the diameter at mean distance) is $4''.46$, and the apparent polar semi-diameter of Saturn, $7''.83$; the horizontal parallaxes, $8''.36$ and $0''.93$ respectively. Hence it is evident that there will be no approach to an occultation. At conjunction the planets will be below the horizon in this country, but will be near the meridian at our Australian observatories; there, however, the least distance between the south limb of Mars and the north limb of Saturn will, according to the Tables, exceed a minute of arc. Mr. Marth has pointed out that the last close conjunction of Saturn and Mars took place on April 18, 1817; the *Berliner Jahrbuch* for that year gives the time of conjunction at 7h. M.T. at Berlin, with Mars 1° S. of Saturn.

An occultation of Saturn by Mars, so far as we know, has not yet been put upon record, nor suspected before the invention of the telescope. The earliest mention of a near approach of the two planets is found in the Chinese annals during the latter days of the 10th moon, A.D. 27; on this occasion Mars, Jupiter, and Saturn were all situate within about 2° from the bright star Regulus; and the same annals record that on July 23, A.D. 143, Mars was very near to Saturn.

BIOLOGICAL NOTES

NATURAL SELECTION AMONG LARVAL SALAMANDERS.—Every case illustrating survival of the fittest has its own interest, as well as its bearing on general laws. The New England salamanders lay large numbers of eggs attached to water plants, and the larvæ are very interesting to watch. In a group that was studied recently, cannibal tendencies soon developed, the stronger eating off the gills of the weaker, at the same time being able to protect their own, within a week or ten days after hatching; these cannibals were fifty per cent. larger than their brethren, and, soon waxing bolder, they began to swallow them bodily. After ten days of the results of such feeding, they were ten or twelve times the size of such weaker brethren as were still left alive. Thus they rapidly developed and passed out of the gill-bearing stage. See Mr. S. F. Clarke, in *American Naturalist* for September.

THE MUSCLES OF THE MAMMALIAN FOOT.—Dr. D. J. Cunningham (*Journal of Anatomy and Physiology*, October, 1878), after dissecting the manus and pes of a large number of mammals, finds that the typical arrangement of the intrinsic muscles of the foot is the same as in the hand, and that this is best seen in certain marsupials. In these animals the muscles are disposed in three layers (1) a plantar layer of adductors; (2) an intermediate layer of short flexors; and (3) a dorsal layer of abductors. Deviations from the type may take place by suppression or by fusion of certain elements of the different layers. Fusion of the members of the intermediate and dorsal layers is very common. The presence of an opponens muscle is not accounted for in the foregoing disposition. When present Dr. Cunningham regards it as derived most commonly from the short flexor, but in many of the carnivora it proceeds from the plantar layer. Further, it is found that in many animals the relation of the intrinsic muscles to the metatarsal bones, both as regards their origin and position, corresponds with transitory conditions in the foot of the human embryo. The adult dog agrees exactly with the first stage of the human fœtus in the relation of the intrinsic pedal muscles to the

metatarsals; the bones are closely compressed together, and the muscles are entirely plantar in position.

SENSITIVE ORGANS IN ASCLEPIADACEÆ.—Robert Brown gave it as his opinion, based on experience, that fertilisation in this family of plants depends largely upon insect agency. Dr. J. G. Hunt has recently published observations on *Stapelia asterias*, whose flower has an extremely disagreeable and animal odour, which appears to attract many flies. Under observation flies were seen eagerly applying their tongues all over the petals and essential organs, apparently eating, with an almost intoxicating relish, the excretion covering those parts. This banquet was indulged in with safety until their tongues came in contact with one of five black spots situated near and alternate with the stamens, when, with amazing quickness, the fly was seized and firmly held by the tongue—a hopeless prisoner. Now a struggle commenced, and if the fly was small and not vigorous, he was retained; if large and strong he escaped, dragging away the black spot and also the pollen-masses, two of which are attached to each trap. The adhesion of the fly's tongue is not caused by any viscid liquid, but by a capital pair of blades, which, when touched lightly by a fly, or even a hair, close instantaneously, and secure the object. Two species of *Asclepias* have been examined by Mr. Edward Potts, and in these he finds that each anther has a pair of sacks or cases in which the pollen masses are suspended so as to make their withdrawal easy. They are closely adherent to the stigma. The sensitive glands are placed in shallow depressions upon the perpendicular columnar ridges of the stigma. The fact of the removal of the pollen masses by insect agency is well known; the question to determine was whether the glands had anything to do with the removal. Mr. Potts caught house-flies and held them by their wings above the flowers, allowing their feet to scramble over them. Almost immediately one or more of these would become ornamented with groups of the glands and pollen-masses, which clung so closely that their later struggles and rubbings failed to detach them. When separate hairs were directed on to a gland, the latter instantly contracted and clung to the hair, tearing itself loose from the stigma, and carrying away the pollen masses with it. On one of the species of *Asclepias* Mr. Potts noticed three flowers which, in addition to its own complete anthers, had one other sensitive gland and its attached pollen-masses, inserted under the edge of a normal anther, and against the sloping lower surface of the stigma. The development of these adventitious pollen-masses was traced till they put forth a profusion of pollen-tubes into the stigma, and the ovaries began to increase in size. Dr. Asa Gray mentions self-fertilisation as occurring in this genus by a similar growth of bundles of pollen-tubes penetrating the stigma at its lower extremity. But here in the presence of the foreign pollen-masses none of the home-grown ones had put forth pollen-tubes. It is conjectured that the maturity of the pollen-masses is reached so late that the stigma of the same flower is frequently unsusceptible. But if the pollen-masses from earlier flowers are removed by insects and lodged upon another just opened, they develop pollen-tubes, and cross-fertilisation ensues. Thus the sensitive glands are not for capture of insects, but to favour cross-fertilisation. (*Proceedings, Acad. Nat. Sci. Philadelphia*, 1878).

THE INHALATION OF PHOSPHURETTED HYDROGEN.—Dr. T. B. Henderson, of Glasgow (*Journal of Anatomy and Physiology*, October, 1878), has investigated the physiological effects of the inhalation of phosphuretted hydrogen gas, by inclosing an animal in an air-tight chamber of known capacity, and subsequently introducing into this a given quantity of the gas. In the first experiment a strong rat was placed in an atmosphere consisting almost entirely of phosphuretted hydrogen, and death

occurred in about ten minutes. An atmosphere containing one per cent. of the gas was found to prove fatal within half an hour. In the case of a large female rabbit, 0.2 per cent. caused death in thirty-three minutes. In these cases the most marked symptom was that of great increase in the number of respirations. Before death, respiration became slow and laboured, and convulsions resembling those of opisthotonus occurred. The ventricles of the heart became most powerfully contracted. Where the strongest dose was administered, the effect on the heart was most marked, and the lungs appeared unaffected. When small quantities of the gas were used, within a very short time the animals began to show signs of suffering from intense irritation of the skin, scratching and biting at it incessantly. Afterwards the creatures seemed to become drowsy, and assumed a very peculiar attitude, sitting down on all-fours, the back bent upwards, and nose pushed backwards between the fore-paws, so as to bring the forehead against the floor of the cage; a rat in this position looked very much like a curled-up hedgehog. A fatal result occurred when the quantity of gas was so small as 1 to 5120. In no case could the odour of the gas be detected in any organ of the body after death. The gas did not appear to exert any local action on the skin.

STRUCTURE AND AFFINITIES OF CHARACEÆ.—This difficult problem has been the subject of recent discussion in the pages of Trimen's *Journal of Botany*. The first paper was in the July number, by Mr. A. W. Bennett, who gave his reasons for dissenting from some generally accepted views of the structure of *Chara*, and from its assignment by Sachs to a place among the Carposporeæ. He objects in the first place to the use of the term "pro-embryo" (Vorkeim) for the immediate product of the germination of the spore, the homologue of the protonema of a moss, and not of the pro-embryo nor suspensor of Selaginellaceæ and Phanerogams. The term sporangium is also frequently misapplied to the nucule, which is in reality an archegonium. The so-called "sporocarp" is formed before and not as the result of fecundation. Finally, Mr. Bennett maintains that Characeæ differ from all the other higher cryptogams in the absence of any alternation of generations, the nearest affinity being with Muscineæ, which they approach in their organs of reproduction. In the September number Prof. Caruel expresses his agreement with Mr. Bennett in removing the Characeæ from the Carposporeæ, but differs in his interpretation of the structure which is the immediate product of germination, the homology of which with the protonema of mosses he contests. He places them in a separate class of their own, intermediate between phanerogams and vascular cryptogams. Finally, in the number for December, Mr. S. H. Vines has a very elaborate essay on the subject. He agrees with both the previous writers in separating the Characeæ from the Carposporeæ, and with Caruel in disputing the homology of the "pro-embryo" with the protonema of a moss, but on the other hand again considers their nearest affinity, though remote, to be with Muscineæ. His principal object is to show that the "pro-embryo" is in reality the embryo of the plant, and that it constitutes in itself the non-sexual generation or sporophore, homologous with the sporogonium of mosses, notwithstanding the apparently anomalous fact that it never produces spores. For such a structure he proposes the term "aposporous sporophore," and compares it to the "apogamous" oophore or prothallium of *Pteris cretica* and some other ferns, which are anomalous in not producing sexual organs of reproduction.

GEOGRAPHICAL NOTES

THE fifty-sixth supplement to Petermann's *Mittheilungen* has just been published, and consists of a masterly treatise on Deltas, by Dr. G. A. Credner, of Halle. The author shows the importance of deltas in reference both to geography and geology, and discusses carefully the real

import of the term. He then, in the first part of his work, treats of the Formation, Structure, Growth, and Distribution of Deltas under the heads of (1) Limit and Form of the Delta; (2) Formation and Condition of the Delta Surface; (3) Size of the Delta; (4) Its Power; (5) Its material; (6) Architecture; (7) Rate of its Growth; (8) Results of its Growth; (9) The Age of Deltas; (10) Number and Geographical Distribution of Deltas; (11) Classification of Deltas. The second part treats of the various causes of the origin of deltas, the causes and conditions of their formation, in which the author discusses various processes of great geological interest. Three sheets of maps accompany this most important paper, showing, among other points, the various deltas of the world.

WE are glad to learn of the early appearance of a work published in Russia under the editorship of M. Semenov, President of the Geographical Society at St. Petersburg. The title is "Illustrated Russia," and it will give a geographical, historical, ethnographical, and statistical description of the country. We notice among the very numerous collaborators all the names well known in the Russian geographical world. The work will contain four folio volumes of sixty to seventy sheets each, and it will be accompanied with numerous illustrations, engraved by the best European firms. Another work of the same kind is undertaken by M. Mordovtseff—"The Ukraine (Little Russia): its History and its People." It will be on the same plan as the well-known work on "Bohemia: its History and its People."

WE are also glad to notice the appearance of the last volume of the "Works of the Ethnographical Expedition sent by the Russian Geographical Society." This volume deals with the south-western provinces of Russia. The expedition was undertaken in 1869, finished in two years, and the printing of the reports, which occupy seven large volumes, has taken since 1872.

WE find in the *Izvestia* of the Russian Geographical Society a notice of the journey of M. Mayeff in Southern Bokhara, last August. After having reached Karshi with an embassy sent to the Emir by the Governor-General of Tashkent, M. Mayeff visited the mountain pass, Ak-bash, which goes from Tenga-khoram to the Kerchak River, and to the great and wealthy village, Kuitan: thence he proceeded by the pass Tenga-daval to Shir-abad. The Kerchak River and its tributary, Kuitan-daria, both mighty mountain streams, were previously quite unknown. The Tenga-daval cleft cuts through the whole mass of the Kuityn-tau, the south-western part of Hissar ridge. From Shir-abad M. Mayeff, going further south, crossed the great Pashkhund ridge, reached the Surkhan river at Kakaity, and traced its banks down to Regar and Sary-djuy. Thence he returned to Shahri-sabs by a very bad route, hardly practicable even on horseback, along the rocky banks of the wild stream, Sengri-dagh. The surveys made during this journey are a most important acquisition for the geography of Central Asia; the highlands of Bokhara, quite unknown until now, will soon receive on our maps an outline in accordance with nature.

THE last number of the *Izvestia* of the Russian Geographical Society contains a report, by Capt. Sidensner, on the possibility of a water communication between the tributaries of the Obi and Yenissei; a very interesting paper, by M. Miclucho Maclay, on the Pelew archipelago, being a description of the people, its customs, administration, and religion; a necrology of M. Chaslavsky; and several notes:—On M. Mayeff's journey to Southern Bokhara, on the Russian cruises to the Obi and Yenissei, and especially statistical ones on printing in Moscow, on trade, ports, and telegraphs in Japan, and on the population and manufactures in governments Tula and Nijni-Novgorod.

DR. EDWIN R. HEATH, to whom we referred some time ago as intending to take up the work of South American exploration commenced by Prof. Orton, and interrupted by his untimely death, left New York on November 18, on the *William H. Keeney*, for Pará, expecting to proceed by steamer to San Antonio, to remain there during the winter, and from that point as a centre to carry on his further investigations. In these he expects to be greatly assisted by Messrs. T. and P. Collins, of Philadelphia, the contractors for the Mamore and Madera Railroad.

THE Woodruff half-educational, half-pleasure expedition round the world has been again organised on a new basis. A steamer of 3,000 tons has been purchased in Europe, and the inclusive fare is 2,500 dollars.

MR. S. E. PEAL communicates to the *Indian Tea Gazette* some remarks on the subject of an overland route to China, *via* the Assam Valley, which are of interest, as there is no attempt to under-rate the great difficulties to be encountered. He justly observes that the merits of the various passes out of Eastern Assam are not well understood, and that it is comparatively easy to draw a line on the map from some point in Upper Assam to the Yangtze or Likiang-fu, and to say, "Why cannot this be done?" Wilcox and others since have sufficiently shown the difficult nature of the country, *via* the Tengapani and the Brahmaputra Valley; what lies beyond the point explored is reputed still worse, and as crossing snow. Northwards again, *via* the Dihong, or Dihong Gorges, the outlet is equally uninviting. The Upper Subansire, or Lopra-cha-chu, is not well explored, though routes not far from it are known to pass for three-quarters of a mile along the face of a precipice 1,500 feet above an abyss, and on a path of stone slabs resting on iron piers let into the face of the rock. The Towang route is, again, difficult, and too far west. South of the Tengapani we have Dapha Búm, 14,500 feet high, with a pass to the south, in which Wilcox's experiences prove how unsuitable it would be for a trade-route. South of Daphapani is the upper portion of the Buri Dihing, and whether there is a route up it crossing Eastern Patkai and going down the Sitka, is not known, though Singphú travel that way. It is one of the routes to be explored, and may give a pass at, perhaps, 5,000 feet elevation or less. The Namrup basin, however, would so far seem to be the only reliable and easy outlet from Eastern Assam: and here is a pass at an elevation of about 1,000 ft., leading *via* Hukong and the Shoemai direct to Western Yunnan, a route which is at present in use. By the Patkai route past Nongyang Lake to the Hukong Valley, Mr. Peal says, we cross at the highest an elevation of 1,500 to 2,000 ft., and fall at once into a beaten track to Yunnan. By this route alone also can the huge snow-clad ridges be turned that stand as barriers east and west of the Upper Irrawadi or Shoemai, and that stretch down from the north to about the parallel of 27°. In point of fact the east-south-east is the only direction in which it is possible to get out of Assam in the direction of China at less than 2,000 ft. above the sea-level.

THE COMPOUND NATURE OF THE ELEMENTS

WE have not yet received from the Royal Society the paper read last Thursday by Mr. Lockyer, in which he brought forward facts indicating the compound nature of the chemical elements. In the meantime the following article from yesterday's *Times* may be of interest; it is evidently written by a chemist who was present when the paper was read:—

"At a crowded meeting such as is seldom witnessed of the Royal Society, on Thursday evening last, Mr. J. Norman Lockyer, F.R.S., read a lengthy paper, in which

he discussed the evidence derived from spectroscopic observation of the sun and stars and from laboratory experiments, which has led him to the conclusion that the so-called elements of the chemist are in reality compound bodies. In order that the line of argument followed by Mr. Lockyer may be understood, it will be necessary briefly to refer to the results of previous researches. As a rule, in observing spectra, the substance to be examined is volatilised in a gas flame or by means of sparks from an induction-coil, and the light is allowed to fall on the slit of the spectroscope; the spectrum is then generally one in which the lines run across the entire field, but by interposing a lens between the spark apparatus and the slit of the spectroscope, Mr. Lockyer was enabled to study the various regions of the heated vapour, and thus to establish the fact, already noted by some previous observers, but to which little attention had been paid, that all the lines in the spectrum of the substance volatilised did not extend to equal distances from the poles. He then showed by the aid of this method that in the case of alloys containing different proportions of two metals, if the one constituent were present in very small quantity, its spectrum was reduced to its simplest form, the line or lines longest in the spectrum of the pure substance alone appearing, but that on increasing the amount of this constituent its other lines gradually appeared in the order of their lengths in the spectrum of the pure substance. Similar observations were made with compound bodies. It was also noticed that the lines furnished by a particular substance varied not only in length and number, but also in brightness and thickness, according to the relative amount present. Armed with these facts, and with the object of ultimately ascertaining, more definitely than has hitherto been possible, which of the elements are present in the sun, Mr. Lockyer, about four years ago, commenced the preparation of a map of a particular region of the spectra of the metallic elements, for comparison with the map of the same region of the solar spectrum. For this purpose about 2,000 photographs of spectra of all the various metallic elements have been taken, and, in addition, more than 100,000 eye observations have been made. As it is almost impossible to obtain pure substances, the photographs have been carefully compared, in order to eliminate the lines due to impurities; the absence of a particular element as impurity being regarded as proved if its longest and strongest line was absent from the photograph of the element under examination. The result of all this labour, Mr. Lockyer states, is to show that the hypothesis that identical lines in different spectra are due to impurities is not sufficient, for he finds short line coincidences between the spectra of many metals in which the freedom from mutual impurity has been demonstrated by the absence of the longest lines. He then adds that, five years ago, he pointed out that there are many facts and many trains of thought suggested by solar and stellar physics which point to another hypothesis—namely, that the elements themselves, or, at all events, some of them, are compound bodies. Thus it would appear that the hotter a star the more simple is its spectrum; for the brightest, and therefore probably the hottest stars, such as Sirius, furnish spectra showing only very thick hydrogen lines and a few very thin metallic lines, characteristic of elements of low atomic weight, while the cooler stars, such as our sun, are shown by their spectra to contain a much larger number of metallic elements than stars such as Sirius, but no non-metallic elements; and the coolest stars furnish fluted band-spectra characteristic of compounds of metallic with non-metallic elements and of non-metallic elements. These facts appear to meet with a simple explanation if it be supposed that as the temperature increases the compounds are first broken up into their constituent "elements," and that these "elements" then undergo dissociation or decomposition into

"elements" of lower atomic weight. Mr. Lockyer next considers what will be the difference in the spectroscopic phenomena, supposing that A contains B as an impurity and as a constituent. In both cases A will have a spectrum of its own. B, however, if present as an impurity, will merely add its lines according to the amount present, as we have above explained; whereas if a constituent of A it will add its lines according to the extent to which A is decomposed and B is set at liberty. So that as the temperature increases the spectrum of A will fade if A be a compound body, whereas it will not fade if A be a true element. Moreover, if A be a compound body, the longest lines at one temperature will not be the longest at another. The paper chiefly deals with a discussion from this point of view of the spectrum of calcium, iron, hydrogen, and lithium, as observed at various temperatures; and it is shown that precisely the kind of change which is to be expected on the hypothesis of the non-elementary character of the elements has been found to take place. Thus each of the salts of calcium, so long as the temperature is below a certain point, has a definite spectrum of its own, but as the temperature is raised the spectrum of the salt gradually dies out and very fine lines due to the metal appear in the blue and violet portions of the spectrum. At the temperature of the electric arc the line in the blue is of great intensity, the violet H and K lines, as they are called, being still thin; in the sun the H and K lines are very thick, and the line in the blue is of less intensity than either, and much thinner than in the arc. Lastly, Dr. Huggins's magnificent star photographs show that both the H and K lines are present in the spectrum of α Aquilæ, the latter being, however, only about half the breadth of the former; but that in the spectrum of α Lyrae and Sirius only the H line of calcium is present. Similar evidence that these different lines may represent different substances appears to be afforded by Prof. Young's spectroscopic observations of solar storms, he having seen the H line injected into the chromosphere seventy-five times, the K line fifty times; but the blue line, which is the all-important line of calcium at the arc-temperature, was only injected thrice. In the spectrum of iron two sets of three lines occur in the region between H and G which are highly characteristic of this metal. On comparing photographs of the solar spectrum and of the spark taken between poles of iron, the relative intensity of these triplets is seen to be absolutely reversed; the lines barely visible in the spark photograph being among the most prominent in that of the solar spectrum, while the triplet, which is prominent in the spark photograph, is represented by lines not half so thick in the solar spectrum. Prof. Young has observed during solar storms two very faint lines in the iron spectrum near G injected thirty times into the chromosphere, while one of the lines of the triplet was only injected twice. These facts, Mr. Lockyer contends, at once meet with a simple explanation if it be admitted that the lines are produced by the vibration of several distinct molecules.

"The lithium spectrum exhibits a series of changes with a rise of temperature precisely analogous to those observed in the case of calcium.

"In discussing the hydrogen spectrum, Mr. Lockyer adduces a number of most important and interesting facts and speculations. It is pointed out that the most refrangible line of hydrogen in the solar spectrum, H_{γ} , is only seen in laboratory experiments when a very high temperature is employed, and that it was absent from the solar protuberances during the eclipse of 1875, although the other lines of hydrogen were photographed. This line also is coincident with the strongest line of indium as already recorded by Thalén, and may be photographed by volatilising indium in the electric arc, whereas palladium charged with hydrogen furnishes a photograph in

which none of the hydrogen lines are visible. By employing a very feeble spark at a very low pressure the F-line of hydrogen in the green is obtained without the blue and red lines which are seen when a stronger spark is used, so that alterations undoubtedly take place in the spectrum of hydrogen similar to those observed in the case of calcium. In concluding this portion of his paper Mr. Lockyer states that he has obtained evidence leading to the conclusion that the substance giving the non-reversed line in the chromosphere, which has been termed *helium*, and not previously identified with any known form of matter, and also the substance giving the 1,474 or coronal line, are really other forms of hydrogen, the one more simple than that which gives the H_{γ} -line alone, the other more complex than that which gives the F-line alone.

"There can be no question that the facts brought forward by Mr. Lockyer are of the highest importance and value, and that they will have much influence on the further development of spectrum analysis, to which he has already so largely contributed. But his arguments are of a character so totally different from those ordinarily dealt with by chemists that they will hesitate for the present to regard them as proof of the decomposition of the elements until either they are assured by competent physicists that they cannot be explained by any other equally simple and probable hypothesis, or until what Mr. Lockyer has foreshadowed as taking place to such an extent in other worlds has been realised beyond question or cavil in our own laboratories. It has been suggested that the same molecule may be capable of vibrating in different ways at different temperatures, and thus of yielding different spectra, just as a bell may give out different notes when struck in different ways; and although Mr. Lockyer has replied to this objection, it can scarcely be regarded as finally disposed of. The fact, however, as Mr. Lockyer has pointed out, that the change from the spectrum of a compound to the lowest temperature spectrum of its metallic element is of a similar character to and even less in degree than the change from the lowest temperature spectrum of the metal to the spectra which it furnishes at higher temperatures does not appear to favour such an hypothesis, and from the similarity in the phenomena it is difficult to deny that in both cases decomposition does not equally take place. Prof. Young's observations on the injection of particular lines into the chromosphere during solar storms are also difficult to reconcile with this view, and if the conclusions drawn from previous researches are correct, it also does not account for the short line coincidences which led Mr. Lockyer to his hypothesis.

"Chemists are careful to teach that what are at present regarded as elements are not necessarily simple bodies, but merely substances which they are unable to decompose or which they have no special reason to regard as compound bodies. The remarkable relations, both in atomic weight and properties, existing between many of the elements, tend, indeed, to show that they are related in the manner Mr. Lockyer supposes. We sincerely hope that he will continue his researches in this direction, and we trust that at no very distant time he may be able to bring forward evidence sufficiently clear to convince even the most sceptical."

NOTES

MR. J. M. WILSON, Mathematical Master at Rugby School, has been elected Master of Clifton College, in place of Dr. Percival, elected President of Trinity College, Oxford. Mr. Wilson has done very much for science at Rugby, and, although Dr. Percival is a difficult man to follow, and has done more probably than any head master for the teaching of science in schools, still we hope that Mr. Wilson will prove a worthy successor to him.

We are indebted to the kindness of Prof. Hayden for the following observation made by his party on the day of the last eclipse of the sun:—"Washington, D. C., November 18, 1878. Observation on total eclipse of the sun. Camp No. 4, Little Sandy, Wyoming Terr., July 29, 1878:—

	m.	sec.
Time of total eclipse as taken by A. D. Wilson	2	27.5
with telescope and theodolite	2	26.0
Mr. James Eccles, with smoked glass	2	27.0
W. H. Holmes, with smoked glass and telescope	2	27.0
of theodolite		
Approximate latitude	42	8 25
" longitude	109	9 52

The weather was very clear and quite calm during eclipse, but was preceded by a heavy wind."

At the recent meeting of the United States National Academy, we learn from *Science News* (the third number of which has reached us), Prof. Davidson incidentally announced that he hoped to be able to observe the intra-Mercurial planets without waiting for eclipses.

THE *Japan Mail* states that an astronomical observatory is to be established within the precincts of the Geographical Bureau of Tokio. The same journal also announces that telegraphic insulators, made at the village of Imari, in the province of Hizen, are of such good quality that they find large sale in Europe.

A SCHEME for the extension of meteorological observations throughout Russia is now being discussed by the Russian government. The Central Meteorological Institution will be located at St. Petersburg. Provincial meteorological institutions will be created in connection with each Russian university, and these provincial institutions will have under their superintendence all meteorological stations of their respective districts, which stations will be largely increased in number.

WE are informed that the Government of New South Wales has requested Mr. William Forster, Agent-General for the Colony, Prof. Liversidge, of the University of Sydney, and Mr. E. Combes, M.P., C.M.G., to collect information in the United Kingdom and on the Continent relative to the working of English and foreign technological museums and colleges, with a view to forming similar institutions in Sydney. A sum of money has been placed on the Estimates by the Government of the Colony, to enable the Committee to purchase suitable specimens. We have no doubt that the Agent-General for New South Wales (3, Westminster Chambers, S.W.) will be extremely glad to receive from such institutions, or from any other source, reports or any information which would assist the Committee in its inquiries.

A CORRESPONDENT writes:—"A singular project is on foot at Paris. M. Camille Flammarion, having published a number of articles to prove that the moon is not destitute of inhabitants, has been led to the idea of constructing a refracting telescope which will be powerful enough to see them. He is now busy organizing a committee to collect the necessary funds. The intended construction will require a million of francs.

AN unexpected difficulty has stopped the construction of the works for the mounting of the great refractor at the Paris Observatory. This instrument is to be erected on the grounds which the Municipal Council had let to M. Leverrier for the nominal sum of 100 francs a year for a period of ninety-nine years. But there is a law that the Government funds cannot be spent for building purposes, except on grounds belonging to the Government; and the Municipal Council, who were so liberal as to the rent, want a high price for the ground.

M. LOCKROY, the editor of the *Rappel*, and representative in the French Chamber of Deputies, has introduced a bill to dis-

pose of the money intended to be spent on the rebuilding of the Tuilleries Palace, for the completion of the isolation of the French national library.

GENERAL MYER has sent orders to Sergeant Jennings to leave in Europe the collections of the works published by the Signal Corps Central Office at Washington, exhibited at Paris. This valuable set has been deposited in the hands of M. Jarry, 46, Boulevard Magenta, Paris, one of the most active members of the Meteorological Society of France, who will be ready to give any information relating to them. It is expected that the series of publications of the United States Signal Corps will be exhibited next spring at the Palais de l'Industrie, in the scientific exhibition and an improved weather indicator will be sent from Washington to be practically tested by predictions adapted to the peculiarities of the French climate.

WE notice the appearance of a Russian work, by M. Starchevsky—"Guide for the Russian in Central Asia"—being a collection of vocabularies of the languages, viz., Turkish (Djagatay, or Uzbek), with an indication of the variations afforded by the Kashgar, Khiva, and Turkoman idioms; Kirghiz; Tartarian (Kazan and Orenburg idioms); Sart, or the town Uzbek; and Tadjik (Bukhara idioms). The vocabularies also contain sketches of the grammars of these languages, the words being given in their Russian transcription. A second volume, containing the Russian, Uzbek, Kirghiz, Tartar, and Tadjik part, will appear shortly.

IT is probably now only a question of time for the electric light to become an everyday institution in our large towns. For several nights satisfactory experiments have been made on Holborn Viaduct, and, under most unfavourable atmospheric conditions, part of the Thames Embankment was illuminated the other evening.

IN Mr. A. S. Wilson's "Experiments on Turnip Seeds" (reprinted from the *Transactions of the Botanical Society of Edinburgh*), he follows out Darwin's idea that "heavy and fine seeds tend to yield the finest plants." Mr. Wilson's conclusions are altogether in harmony with those of Darwin. The mean of a large number of experiments gave a product of 2 lbs. 7 oz. per seed in the case of large seeds, as against 2 lbs. 1½ oz. in the case of small seeds.

IN his just published report on the trade of Chinkiang, on the Yangtze-kiang, H.M.'s Consul mentions that there are rumours that the coal, iron, and plumbago mines in that neighbourhood are to be opened without delay, under the auspices of the Viceroy, Li Hungchang. A British engineer in the employ of the Chinese Government has recently visited these mines and reported on them to the Viceroy Shên, at Nanking.

THE limit of permanent snow in the Caucasus is very variable, this mountain-group, of 156 geographical miles, lying between two seas and several steppe-regions, being consequently subject to the most opposite meteorological conditions. The average height of the snow-line on the Elburs, the highest point of the Caucasus, is 10,885 feet. The average height of the lower limits of the glaciers on the Elburs is 8,216 feet. The Kasbek is the centre of another region of glaciers and permanent snow-fields, in which the true situation of the snow-line is not yet accurately ascertained. A third region comprises the high ranges of the schist-system of Perikitel and Bogoz in Daghestan. The fourth region is the Schathdag, south of Daghestan, ten geographical miles from the Caspian Sea. In this last region the snow-limit reaches to 10,374 English feet above the sea-level. The average height of the snow-limit within the Caucasus is 10,600 feet. Local variations upwards and downwards are frequent, and there may be a difference of 3,200 feet between the maximum and the minimum. In the West Caucasian regions these conditions

resemble those of South Europe; in the Eastern region they offer an analogy with those of Asiatic mountain-groups, influenced by a continental climate. During the last few years some glaciers in the western half of the Caucasus have been retrograde, just as it has been observed with those of the Alps during these last fifteen years. In 1849 several Caucasian glaciers were evidently advancing through ancient forests. The glacier of the Kasbeko, especially of Deftoraki, after having followed for some time the general retrograde movement, lately began to move forward again. Experience has proved, that, whenever this movement reaches a certain amount, the end of the glacier is broken away, and may cause serious catastrophes, as it did by stopping the chief military road from Tiflis along the Terek valley to Vladikawkas. Such observations are thus of high practical importance. The Deftoraki glacier may be paralleled with the Rosenthal and Vernagt glaciers of the North Tyrol, considering their variable periods and extreme alternations of progression and retrogression. For further details we refer to Dr. Abich's paper in *Proceed. Imper. Geol. Instit. Vienna*, March 5, 1878.

REPORTS come to *Science News* of a remarkable and very extensive series of caves discovered in Page county, Virginia, which, it is said, a scientific expedition will probably soon examine. Their great area, variety, curious formation, and natural ornaments, if the stories about them be true, are sufficient to place them among the wonders of the world.

We have received Decade I. of a "Prodrômus of the Zoology of Victoria, or Figures and Descriptions of the Living Species of all Classes of the Victorian Indigenous Animals," by Prof. F. McCoy (London: Trübner and Co.). The plates in this first part are most beautifully coloured, and do infinite credit to the skill of the colony. There are three plates of snakes, three of fish, one of the giant earth-worm (*Megascolides australis*, McCoy), one devoted to three species of the day-moth, and the last two to two species of diurnal lepidoptera.

THE Commission for the Survey of New York State has been reappointed with an appropriation of 14,300 dollars a year. A large amount of preliminary work has been done under Mr. J. S. Gardner.

ACCORDING to a note published by the *Norddeutsche Allgemeine Zeitung*, Berlin time will become the only one in use in the whole of the German Empire. The difference in time is thirty minutes minus on the coast of the German Ocean, and thirty-seven in advance in the eastern parts of Bavaria. This resolution has been fostered by a similar reform lately established in Sweden.

M. BARDOUX has re-organised the French Central Society of Agriculture, which will be styled the National Society of Agriculture. It will be composed of 82 ordinary members, 10 foreign members, 150 corresponding members in France and Algeria, and 50 foreign corresponding members. The President of the Republic is to be *ex officio* the patron of this Society, and the Minister of Agriculture and Trade the honorary president.

AN earthquake was felt in Cologne and vicinity on December 10 at 11.35 A.M. A similar commotion was felt in the provinces of Luxemburg and Namur, principally on the borders of the Ardennes forest; on the same day at 11.28 Brussels time. The duration of the shock was eight seconds, and it was accompanied by a well-defined noise, which awoke the inhabitants. On the following morning a meteor was observed at six o'clock in Alsatia, from Mulhausen to Colmar. A fire-ball travelling from north-west to south was seen exploding, exhibiting a display of natural fire-works. No noise was heard by any observer.

At the last meeting of the Manchester Anglers' Association, Mr. F. J. Faraday, F.L.S., in reading a paper on the "Mind

of Fishes," recounted an instance of apparent intelligence in a skate, observed by the author while, officiating as curator of the Manchester Aquarium. On the occasion in question a morsel of food thrown into the tank fell directly in the angle formed by the glass front and the bottom. The skate, a large specimen, made several attempts to seize the food, but owing to the position of the mouth on the under-surface of the head, and the closeness of the food to the glass, he was unable to do so. He lay quite still for a while "as though thinking;" then, suddenly raising himself in a slanting posture, the head inclined upwards and the under-surface of the body towards the food, the creature waved his broad expanse of fins and thereby created an upward current or wave in the water, which lifted the food from its position and carried it straight into his mouth.

At the Royal Institution a Course of Six Lectures (adapted to a juvenile auditory) on a Soap Bubble, will be given by Prof. Dewar, M.A., F.R.S., at 3 o'clock, on December 28, 31, January 2, 4, 7, 9 (1879).

ON the New Jersey bank of the Delaware River, the skeleton of a man has recently been found buried in a standing position in a red sandy bluff overlooking the stream. A few inches below the surface the neck bones were found, and below these the rest of the skeleton except the bones of the hands and feet. The skull being wanting, it could not be determined whether the remains were those of an Indian or a white man; but the burial was peculiarly aboriginal. It was found that around the lower extremities were placed a number of large stones, showing traces of fire, together with charred wood; and there was no doubt that the bones of the feet had been burnt. Probably the man had been executed as a prisoner of war, being placed erect in the pit with a fire around his feet. He would appear to have been then buried, with the exception of his head. The skeleton when complete must have been six feet high.

THE new instalment of the *Transactions* of the Asiatic Society of Japan contains several papers of considerable interest. Mr. E. M. Satow, the Japanese Secretary of H.B.M.'s Legation at Tôkiô, who was one of the earliest labourers in the field of Japanese literature, contributes articles on the "Korean Potters in Satsuma," and the "Use of the Fire-Drill in Japan;" Mr. Aston one on "Hideyoshi's Invasion of Korea," and Mr. R. W. Atkinson "Notes on the Manufacture of *Oshiroi*" (white lead). There are also two contributions on earthquakes in Japan, and notes on some of the volcanic mountains of the empire.

PEAT FUEL is much used at Bremen and in other parts of North-western Germany, and increased attention has been paid of late years to its production and preparation. We learn from Consul Ward's Report that the vast tracts of marshy moors which are to be found in many parts of the German Empire, and more especially between the River Elbe and the Dutch frontier, are regarded as containing an immense amount of wealth in the form of peat fuel. With the view of developing and improving the present means of producing and manufacturing this article, and of extending its consumption to districts where fuel is dear, an association was formed at Königsberg a few years ago, and was reconstituted last year at Schwerin. Their intention is to diffuse technical knowledge throughout the country with regard to peat production and manufacture.

THE Annual Report of the Belfast Naturalists' Field Club for 1876-77, contains a variety of matter, some of it of considerable scientific interest. There is a brief account of the excursions in connection with the Club, embracing a good deal of topographical, antiquarian, and other information. At the winter session a variety of papers were read, some of which are reported at greater or less length. In connection with Mr.

William Gault's detailed "Observations on the Geology of the Black Mountains," a coloured diagram is given. The Appendix contains papers by Mr. Joseph Wright on "Recent Foraminifera of Down and Antrim," and by Messrs. Swanston and Lapworth on the "Correlation of the Silurian Rocks of Co. Down."

THE Twentieth Report of the East Kent Natural History Society is, on the whole, satisfactory. It contains abstracts of several good papers read at the meetings. The Society has ninety-three members.

EXCAVATIONS in the "Dragon Cave" at Mixniz, Styria, have been already noticed (NATURE, vol. xviii. p. 618). The diggings made in June, 1878, by the Anthropological Society of Graz, have brought to light some bones bearing indistinct marks of cutting and percussion. Above the stalagmitic layer over the hearth-stuff some bones were found, in loam, well preserved, but probably derived from an older site. They are greenish, and partly of an intense bluish-green tint; and Prof. C. Doelter finds that their composition approaches that of turquoise [bone-turquoise?]. A full account by Prof. R. Hoernes will be found in the *Proc. Imp. Geol. Instit. Vienna*, August 31, 1878.

THE additions to the Zoological Society's Gardens during the past week include a Yellow Baboon (*Cynocephalus babuin*), from West Africa; two Ring-tailed Lemurs (*Lemur catta*), from Madagascar, presented by Mr. G. A. Shaw; a Green Monkey (*Cercopithecus callitrichus*), from West Africa, presented by Mr. J. Williams; a Common Fox (*Canis vulpes*), British, presented by Mr. Sutton Sharpe; a Woodcock (*Scolopax rusticola*), European, presented by Messrs. E. and W. H. Davis; a Common Swan (*Cygnus olor*), European, presented by Capt. Marx; a Ring-tailed Lemur (*Lemur catta*), from Madagascar, deposited; an Ocelot (*Felis pardalis*), from America; a Cereopsis Goose (*Cereopsis nova-hollandiae*), from Australia; three Yellow-winged Blue Creepers (*Careba cyanea*), from South America, purchased.

ON HELIOTROPISM IN PLANTS

THE heliotropic phenomena in plants form the subject of a monograph by Herr Wiesner, the first part of which has been recently communicated to the Vienna Academy. The following outline from the *Anzeiger* of the Academy will give an idea of some of the fruits of the author's researches on this important subject.

The first section treats of the history of the subject. In the second section the author studies the influence of light on heliotropism. The experiments were made in the light of a gas flame which burned under a constant pressure with a uniform intensity (luminous power = 6.5 spermaceti candles). The unit for the measurement of the light-intensity was the strength of this flame at the distance of one metre. It was found that in heliotropism three cardinal points of light-intensity are to be distinguished; an upper limit, a lower limit, and between the two an optimum of light intensity. Thus with decreasing intensity of light the strength of the heliotropic effect increases to a certain point, and beyond this point decreases. The lower limit referred to coincides with the lower limit of light-intensity for the stoppage of growth in length, while the upper limit does not coincide, or only occasionally coincides, with the upper limit of light-intensity for growth in length, for in the case of plants very sensitive heliotropically it lies higher, and in less sensitive plants lower, than the upper limit for growth in length. The mode of arrangement of the experiment in gas-light did not permit of determining in all cases the limiting values of the light-intensities; thus, for example, the upper limit for the heliotropism of etiolated shoots of *Salix alba*, and of the hypocotylous portion of the stem of *Viscum album*, and the lower limit for the heliotropism of the growing stem of vetch could not be ascertained. The former lies above 400, the latter far below 0.008. The optima were found to lie between 0.11 (the growing stem of the pea) and 6.25 (etiolated shoots of *Salix alba*). Both with gas-light and with natural light it was ascer-

tained that beyond a certain intensity no growth in length occurs.

The third section treats of the relations between the refrangibility of the light rays, and the heliotropic effects. The experiments were made partly in the objective spectrum, partly in varieties of light, got by sending white light through coloured solutions. . . . It was proved that portions of plants very sensitive heliotropically, e.g., growing stems of *Vicia sativa*, undergo curvatures in all kinds of light, even in ultra-red and ultra-violet, with the exception of yellow. The maximum of the heliotropic force of light lies at the boundary between violet and ultra-violet; a second (smaller) in the ultra-red. From both maxima the power of the rays to produce heliotropism decreases gradually on to the yellow. Portions of plants little sensitive heliotropically, are no longer influenced by orange, or by red and green, or even (in the case of etiolated shoots of *Salix alba*) by ultra-red rays. The yellow rays quite stop the heliotropism, for, e.g., in pure red a quicker and stronger heliotropism occurs than in a light which gives yellow besides red.

In the fourth section experiments are described on the joint action of (positive and negative) heliotropism and (positive and negative) geotropism. It is here shown, *inter alia*, that, in the case of plants very sensitive heliotropically, the geotropism is, at the optimum of light-intensity, apparently extinguished, even in strongly geotropic organs; further, that in many organs (growing stem of the pea), the heliotropic and geotropic powers of curvature disappear simultaneously; in others, however (stems of cress), the younger portions of the stem are more strongly heliotropic than the older, and the oldest after-growing portions of stem no longer show bendings in the light, but, through drawing action on one side (the heliotropic overhanging point of the stem), show apparently heliotropic curvatures chiefly due to growth, which are then counteracted by negative geotropism.

The arguments which go to prove that heliotropism is due to the phenomenon of unequal growth upon unequally-lit sides of an organ are set forth in the next section, and proof is offered that, for heliotropism as well as for growth in length, free oxygen is necessary.

The last chapter furnishes proof that the conditions for heliotropism remain constantly the same during its course, and coincide with the conditions for growth in length; further, that heliotropism (and the same holds good for geotropism) occurs as a phenomenon of induction. In this chapter it is also shown that when light induces heliotropism in an organ, a fresh heliotropic or geotropic induction meets with resistances, and can only come into action after extinction of action of the first; and that successive impulses of light and gravity, of which each by itself is capable of producing certain effects, do not have their actions added together when the effects that should be obtained separately are in the same direction, e.g., one and the same side of the organ is helped in its growth in length.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, December 5.—"On a Machine for the Solution of Simultaneous Linear Equations," by Sir William Thomson. Let $B_1, B_2, \dots B_n$ be n bodies each supported on a fixed axis (in practice each is to be supported on knife-edges like the beam of a balance).

Let $P_{11}, P_{21}, P_{31}, \dots P_{n1}$ be n pulleys, each pivoted on B_1 ;

$P_{12}, P_{22}, P_{32}, \dots P_{n2}$ " " " B_2 ;

$P_{13}, P_{23}, P_{33}, \dots P_{n3}$ " " " B_3 ;

" $C_1, C_2, C_3, \dots C_m$ be m cords passing over the pulleys;

" $D_1, P_{11}, P_{12}, P_{13}, \dots P_{1n}, E_1$ be the course of C_1 ;

" $D_2, P_{21}, P_{22}, P_{23}, \dots P_{2n}, E_2$ " " " C_2 ;

" $D_3, P_{31}, P_{32}, P_{33}, \dots P_{3n}, E_3$ be fixed points;

" $l_1, l_2, l_3, \dots l_n$ be the lengths of the cords between D_1, E_1 , and D_2, E_2, \dots and D_n, E_n , along the courses stated above, when $B_1, B_2, \dots B_n$, are in particular positions which will be called their zero positions;

Let $l_1 + e_1, \dots l_2 + e_2, \dots l_n + e_n$ be their lengths between the same fixed points, when $B_1, B_2, \dots B_n$ are turned through angles $x_1, x_2, \dots x_n$ from their zero positions;

(11), (12), (13), ... (1n),

(21), (22), (23), ... (2n),

(31), (32), (33), ... (3n),

.....

quantities such that

$$\left. \begin{aligned} (11)x_1 + (12)x_2 + \dots + (1n)x_n &= e_1 \\ (21)x_1 + (22)x_2 + \dots + (2n)x_n &= e_2 \\ (31)x_1 + (32)x_2 + \dots + (3n)x_n &= e_3 \\ &\dots\dots\dots \\ (n1)x_1 + (n2)x_2 + \dots + (nn)x_n &= e_n \end{aligned} \right\} \dots\dots\dots (I).$$

We shall suppose x_1, x_2, \dots, x_n to be each so small that (11), (12), ... (21), &c., do not vary sensibly from the values which they have where x_1, x_2, \dots, x_n are each infinitely small. In practice it will be convenient to so place the axes of B_1, B_2, \dots, B_n , and the mountings of the pulleys on B_1, B_2, \dots, B_n , and the fixed points $D_1, E_1, D_2, \dots, E_n$, that when x_1, x_2, \dots, x_n are infinitely small, the straight parts of each cord and the lines of infinitesimal motion of the centres of the pulleys round which it passes are all parallel. Then $\frac{1}{2}(11), \frac{1}{2}(21), \dots, \frac{1}{2}(n1)$ will be simply equal to the distances of the centres of the pulleys $P_{11}, P_{21}, \dots, P_{n1}$, from the axis of B_1 ;

$\frac{1}{2}(12), \frac{1}{2}(22), \dots, \frac{1}{2}(n2)$ the distances of $P_{12}, P_{22}, \dots, P_{n2}$ from the axis of B_2 , and so on.

In practice the mountings of the pulleys are to be adjustable by proper geometrical slides, to allow any prescribed positive or negative value to be given to each of the quantities (11), (12), ... (21), &c.

Suppose this to be done, and each of the bodies B_1, B_2, \dots, B_n to be placed in its zero position and held there. Attach now the cords firmly to the fixed points D_1, D_2, \dots, D_n respectively; and, passing them round their proper pulleys, bring them to the other fixed points E_1, E_2, \dots, E_n , and pass them through infinitely small smooth rings fixed at these points. Now hold the bodies B_1, B_2, \dots each fixed, and (in practice by weights hung on their ends, outside E_1, E_2, \dots, E_n) pull the cords through E_1, E_2, \dots, E_n with any given tensions T_1, T_2, \dots, T_n . Let G_1, G_2, \dots, G_n be moments round the fixed axes of B_1, B_2, \dots, B_n of the forces required to hold the bodies fixed when acted on by the cords thus stretched. The principle of "virtual velocities," just as it came from Lagrange (or the principle of "work"), gives immediately, in virtue of (I),

$$\left. \begin{aligned} G_1 &= (11)T_1 + (21)T_2 + \dots + (n1)T_n \\ G_2 &= (12)T_1 + (22)T_2 + \dots + (n2)T_n \\ &\dots\dots\dots \\ G_n &= (1n)T_1 + (2n)T_2 + \dots + (nn)T_n \end{aligned} \right\} \dots\dots\dots (II).$$

Apply and keep applied to each of the bodies, B_1, B_2, \dots, B_n (in practice by the weights of the pulleys, and by counter-pulling springs), such forces as shall have for their moments the values G_1, G_2, \dots, G_n , calculated from equations (II) with whatever values seem desirable for the tensions T_1, T_2, \dots, T_n . (In practice, the straight parts of the cords are to be approximately vertical, and the bodies B_1, B_2, \dots, B_n are to be each balanced on its axis when the pulleys belonging to it are removed, and it is advisable to make the tensions each equal to half the weight of one of the pulleys with its adjustable frame.) The machine is now ready for use. To use it, pull the cords simultaneously or successively till lengths equal to e_1, e_2, \dots, e_n are passed through the rings E_1, E_2, \dots, E_n , respectively.

The pulls required to do this may be positive or negative; in practice, they will be infinitesimal, downward or upward pressures applied by hand to the stretching weights which remain permanently hanging on the cords.

Observe the angles through which the bodies B_1, B_2, \dots, B_n are turned by this given movement of the cords. These angles are the required values of the unknown x_1, x_2, \dots, x_n , satisfying the simultaneous equations (I).

The actual construction of a practically useful machine for calculating as many as eight or ten or more of unknowns from the same number of linear equations does not promise to be either difficult or over-elaborate. A fair approximation being found by a first application of the machine, a very moderate amount of straightforward arithmetical work (aided very advantageously by Crelle's multiplication tables) suffices to calculate the residual errors, and allow the machines (with the setting of the pulleys unchanged) to be re-applied to calculate the corrections (which may be treated decimally, for convenience): thus, 100 times the amount of the correction on each of the

original unknowns, to be made the new unknowns, if the magnitudes thus falling to be dealt with are convenient for the machine. There is, of course, no limit to the accuracy thus obtainable by successive approximations. The exceeding easiness of each application of the machine promises well for its real usefulness, whether for cases in which a single application suffices, or for others in which the requisite accuracy is reached after two, three, or more of successive approximations.

Mathematical Society, December 12.—Mr. C. W. Merrifield, F.R.S., president, in the chair.—Prof. W. S. Jevons, F.R.S., was elected a Member.—The following communications were made to the Society:—Mr. H. Perigol, on a kinematic paradox (the rotameter); Mr. S. Roberts, F.R.S., on the forms of numbers determined by continued fractions; Prince Camille de Polignac, on a graphic construction of the powers of a linear substitution.

Linnean Society, December 5.—Prof. Allman, F.R.S., president, in the chair.—Dr. I. Balfour Balfour demonstrated the peculiarities of a rare Myxomycetes, which species of Heterodictyum he showed bore characters intermediate between Cribraria and Dictydium.—Mr. G. Murray called attention to a peculiar greenish-yellow fungus (*Hygrophorus Wynnii*, Berk.?) from Bridlington, Yorkshire.—Examples of a moss new to Britain, the *Aulacomnium turgidum*, were shown by Mr. E. M. Holmes, who stated that they were found by Mr. West and Dr. F. Arnold Lees in Yorkshire; a comparison between the above and the common *A. falustre* was made.—Mr. F. H. Waterhouse read a paper on some Coleoptera collected by Charles Darwin, of geographical interest. These had lain undetermined for a long series of years, and now prove new to science. *Phytosus Darwinii*, from the Falklands, has unusually long, slender claws; *Choleva falklandica* is elliptical-shaped and strongly punctated. *Elmis brunnea* and *Anthicus Wollastoni*, from St. Helena, are noteworthy, inasmuch as Mr. Wollaston ("Coleop. St. Hel.") does not record either genus as existent there. *Scaphisoma dongatum*, from Rio de Janeiro, is the first species of the genus known to inhabit South America; and *Prosthetops (P. capensis)* is a novel genus with two ocelli, from South Africa.—Mr. C. B. Clarke, in a note on *Gardenia turgida*, stated that in books the flower calyx of males was alone described, while all herbaria specimens are dioecious, and males and females have hitherto been referred to different genera. The precise characters of each were denoted.—Dr. F. Day gave a summary of his (third) concluding paper on the geographical distribution of the Indian fresh-water fishes, in this dealing with the families Scombresocidae, Cyprinodontidae, Cyprinidae, Notopteridae, and Symbbranchidae. Among the eighty-seven genera two only are African, thirty-two extend to the Malay Archipelago, and twelve are common to Africa and Malaya; of 369 species two are African, twenty-seven Malayan, and two common to both regions. In short, the fresh-water fish affinities preponderate to the Indo-Chinese and Malayan sub-regions; thus supporting Mr. Wallace's opinion as opposed to the view held by Mr. Blandford, who gives greater weight to African relationships, at least so far as mammals are concerned. Dr. Day, moreover, contends that the Indian fresh-water fishes point to three subordinate separate faunas—1. That belonging to the Ghauts, Ceylon, the Himalayas, and Malay Archipelago; wherein may be distinguished two fish races, a Palearctic and a Malayan. 2. A fauna of the plains west of the Indus, with an African element in it. 3. That (by far the largest) spread over the plains east of the Indus, and which appears to have a Burmese connection.—The abstract was read of a second contribution on the mollusca of the *Challenger* Expedition, by the Rev. R. Boog Watson. This consisted of descriptions of species of Trochidae belonging to four genera, viz., *Squinzia*, *Basillissa*, *Gaza*, and *Bembix*; the three last being new and otherwise remarkable.—Messrs. Dowdeswell, Arthur Hammond, Thos. Hanbury, Joseph Sidebotham, Wm. Thomson, and Chas. A. Wright were elected Fellows of the Society.

Zoological Society, December 3.—Mr. Robert Hudson, F.R.S., vice-president, in the chair.—Mr. H. Seebohm, F.Z.S., exhibited a series of specimens of the hooded and carrion crows, and made remarks on their intermediate forms and geographical distribution.—Col. L. H. Loyd Irby, F.Z.S., exhibited and made remarks on the nests, eggs, and young of *Cypselus pallidus*, taken at Gibraltar.—Mr. Howard Saunders, F.Z.S., exhibited and made remarks on some eggs of Indian Laridae (*Sterna bergii* and *Larus hemprichii*), which had been taken by

* The idea of force here first introduced is not essential, indeed is not technically admissible to the purely kinematic and algebraic part of the subject proposed. But it is not merely an ideal kinematic construction of the algebraic problem that is intended; and the design of a kinematic machine, for success in practice, essentially involves dynamical considerations. In the present case some of the most important of the purely algebraic questions concerned are very interestingly illustrated by these dynamical considerations.

Capt. Butler, of H.M.'s 83rd Regt., on the Mekran Coast.—Dr. Day, F.Z.S., exhibited and made some remarks on some jaws of Indian sharks belonging to the genera *Galocercus* and *Carcarias*.—The Secretary called attention to an error which had been made in reference to the collection of butterflies from Billiton, reported on by Messrs. Godman, Salvin, and Druce, in the last part of the Society's *Proceedings*. The collection had been made and forwarded to England by Herr J. G. F. Riedel, of Koepang.—Mr. Sclater communicated some further particulars respecting the occurrence in Lancashire of the specimen of the black-throated Wheatear (*Saxicola staphazina*) exhibited at the last meeting of the Society.—Prof. A. H. Garrod, F.R.S., read a paper on the conformation of the thoracic extremity of the trachea in the birds of the order Gallinae.—A communication was read from Dr. A. Günther, F.R.S., containing the description of some reptiles from Midian, collected by Major Burton. Amongst these were two new snakes proposed to be called *Echis decorata* and *Zamenis degantissima*.—Mr. H. Seebohm pointed out the character of a new Sylvia from Abyssinia, proposed to be called *Sylvia blanfordi*, after Mr. Blandford, by whom it was obtained during the Abyssinian Expedition.—Mr. H. Seebohm also read notes on the identity of the birds which had been named *Hororn fortipes*, *Neornis assimilis*, *Horreites robustipes*, *H. brunneus* and *H. pallidus*, and proposed to reduce them to one species under the name *Cedtia fortipes*.—Mr. Martin Jacoby read descriptions of some new species of Phytophagous Coleoptera from Central and South America.

Anthropological Institute, November 26.—Mr. John Evans, F.R.S., president, in the chair.—The Rev. John Robbins, D.D., was announced as a Member.—Mr. Worthington G. Smith exhibited a series of flint implements from the valley of the River Lea.—Mr. A. L. Lewis read a paper on the evils arising from the use of historical national names as scientific terms. The propositions which he endeavoured to establish were: 1. That there were at the first population of Europe certain primitive races, of which three are particularly described. 2. That these races are so mixed that at the present day the representatives of them appear not only in most European nations, but in the same families and among children of the same parents. 3. That notwithstanding this mixture and the effects which it must permanently have, racial characters display an astonishing permanence. 4. That this mixture, being so slow in its effects and yet having become so general, has probably been at work for a very great length of time—so great that the peoples to whom the earliest history introduces us were probably nearly as much mixed as those of the present day. 5. That it is desirable to discontinue the use of political names for those peoples as ethnic names, and to employ others, based on the physical characteristics of the individual. 6. That while physical characteristics are the only basis for a true division into races, yet in the practical application of this division the influence upon individuals of different races of a community of language, custom, history, or tradition must not be lost sight of, although these things do not prove community of race, but only the contact at some time or other of the races to whom they are now common.—The director read a paper by Prof. Daniel Wilson, LL.D., on some American illustrations of the evolution of new varieties of men. In the mingling of different races in America, so complex and varied, all subjected to the influences of climate and social habits, and all mingling in blood in a greater or less degree with the native red races, hybridity had resulted on a great scale. The process had already been developed sufficiently long to afford important indications of the evolutions of permanent hybrid varieties. A specimen is to be seen among the tribes of the half-breeds in Manitoba, as it were in the process of evolution; while sheltered within the remote Arctic regions man can be studied among the Esquimaux in conditions closely analogous to those which are ascribed to a post-pliocene, if not to a pre-glacial period. In the abrupt collision of the civilised races of Europe with the American aborigines, it had always been taken for granted that the latter were doomed to inevitable extinction, and that the land would be peopled with the purely civilised races of the world. There is no question, however, that from an early date there have been intermarriages between Europeans and the American races. A growing feeling is manifesting itself in the United States and Canada that the Indian population is not doomed to extinction, and that a much larger amount of healthy intermarrying and consequent absorption has existed than unobserving critics had any conception of, and the native Indian element is a factor in the population of the New

World destined to exercise an enduring influence on the ethnical character of the Euro-American races.

CAMBRIDGE

Philosophical Society, November 4.—The following communications were made to the Society:—The physical constants of hydrogenium, by Prof. Dewar, Part 2. This paper is a continuation of an investigation into the physical constants of hydrogenium. The first part appeared in the *Transactions* of the Royal Society of Edinburgh, vol. xxvii., and had reference to the specific gravity, specific heat, and coefficient of expansion of the occluded hydrogen. These observations led to the conclusion that the specific gravity was independent of the amount of condensed gas, and had a mean value of 0.62. This result has been confirmed by the subsequent experiments of Troost and Hautefeuille, and what is very remarkable, they deduce an identical value for the density of hydrogen from observations on the hydrides of potassium and sodium. The specific heat, relatively to palladium, of the condensed hydrogen, appeared to vary inversely as the charge, but taken relatively to successive charges was nearly constant, and had the value 3.4, which is identical with that of gaseous hydrogen at constant pressure. The coefficient of the cubical expansion of the alloy is about twice that of palladium, and that of the hydrogen in its compressed state not more than three times that of mercury. This communication deals with the thermo-electric relations and conductivity of hydrogenium. It is shown that the electro-motive force of a junction of hydrogenium palladium is at ordinary temperatures nearly equal to that of an iron copper junction, and that it increases with the temperature according to the general parabolic law, the rate of the increase being, however, greater than iron copper and subject to a regular variation on account of successive heatings. The formation of thermo-electric piles, and of neutral points in a uniform wire of this substance, along with the continuous formation of thermo-electric currents through the application of a hydrogen flame were explained and shown. Experiments on the electric resistance show that it increases directly as the amount of condensed gas.—Studies in spectrum analysis, by Professors Livinge and Dewar. The authors describe the reversal of characteristic lines of rubidium and caesium when the chlorides are heated with sodium in glass tubes in an atmosphere of hydrogen or nitrogen, and a bright light is viewed through the vapours. They remark that the violet lines of rubidium, and the most refrangible of the caesium lines are first seen, and broaden out the most when the temperature rises, contrary to what might have been expected from the analogy of other cases. The absorption lines observed coincided with the bright lines of the metals heated in a flame, not with the lines which they give in a dense electric spark; but the authors obtained spectra similar to the flame spectra by passing sparks from an induction coil without a Leyden jar, between beads of fused chlorides of those metals, although simpler spectra were produced by the more abrupt discharges produced by interposing a Leyden jar. The authors further described absorption spectra produced by magnesium vapour when mixed with hydrogen, potassium, and sodium respectively. That produced by magnesium and hydrogen consisted of a line a little less refrangible than the δ group, and a band rather more refrangible than the δ group, fading away towards the blue. The constant appearance of these absorptions when the vapour of magnesium in hydrogen was observed in a hot iron tube, led to the endeavour to obtain the corresponding luminous spectrum. This they succeeded in doing by taking sparks from an induction coil, without a Leyden jar between magnesium wires in a tube full of hydrogen. It appears that the compound to which this spectrum is due is formed only within a certain range of temperature, and is dissociated at higher temperatures—for the spectrum is scarcely seen at all when a large Leyden jar is used, which may be supposed to have the effect of shortening the time of discharge and increasing the temperature. Further, this compound does not seem to be formed when the pressure of the hydrogen is much reduced. In the case of sodium and magnesium they observed an absorption line in the green not observed in either vapour separately; and when potassium and magnesium were used, a characteristic pair of lines in the red always appeared, and sometimes another line in the blue. The authors have not yet seen these as bright lines. In the course of observations on the spectra of sundry rarefied gases the authors have been led to conclude that electric sparks take a selective course in a mixture of gases, and that the differences in the spectra

observed in different parts of the same tube are probably due to the existence of more than one gas in the tube. Tubes of nitrogen which did not show the lines of hydrogen at all when sparks from an induction coil without a Leyden jar were passed through them, gave strong hydrogen lines when a large jar was interposed. A bulb tube with magnesium wires filled with hydrogen at low pressure gave in one half scarcely any spectrum but the F-line of hydrogen, while the other half gave the spectrum of acetylene. They generally found hydrogen lines and flashes of sodium (no doubt from the glass) in tubes very much exhausted; and they conclude that impurities enter such tubes from sources hitherto unsuspected. Tubes filled with oxygen obtained from silver iodate have been found to give the spectrum of iodine, pointing to the conclusion that chemical reactions occur at very low pressures which are not produced under other circumstances. Generally the authors conclude that the spectrum of a gas in a rarefied state affords the most delicate test of its purity, and that it is to the chemical problem of obtaining pure gases that attention needs to be specially directed.

PARIS

Academy of Sciences, December 9.—M. Fizeau in the chair.—The following papers were read:—New method for determining the flexion of telescopes, by M. Loewy. The principle is to produce in the field, besides the images of the eyepiece and objective (whose position may vary), a third image emanating from the axis of rotation, which, completely independent of the flexion of the tubes, undergoes only a slight displacement due to the auxiliary lens. This image serves as a means of estimating the relative displacement of the two others. (A concavo-convex lens is placed in the axis of the central cube, and on its axis of rotation.)—Examples of calculation of the torsion of prisms with mixtilinear base, by M. de Saint-Venant.—On the binary form of the seventh order, by Prof. Sylvester.—Study on ordinary and compound steam engines, steam jackets, and superheating, according to experimental thermodynamics, (extract), by M. Ledieu. Some observations are here made on neutral spaces and their influence, the restriction of these having been one direction of recent improvement.—On the works of the Saint Gothard tunnel, by M. Colladon. After recounting obstacles which have retarded the work—among others, greatly increased and violent infiltration, and the swelling of a plastic mass of decomposed felspar and gypsum on contact with moist air, exerting tremendous pressure on supports—he gives information about the air compressing and ventilating apparatus and the boring machines. It is expected that about eight years will suffice for the completion of the work. The difference between the first estimated and actual expense will, it is thought, be nearly 100 million francs.—On a series of soundings undertaken by M. Roudaire in view of the formation of the African interior sea, by M. De Lesseps. These soundings will cover about 500 leagues, and will occupy M. Roudaire about six months, after which it will be possible to estimate fairly the expense of the project. M. De Lesseps describes what he saw of that region.—Report on a memoir of Prof. Lawrence Smith on the native iron of Greenland and the dolerite it contains. The reporters recommend insertion of this interesting memoir in the *Recueil des Savants étrangers*.—Diseases of plants caused by *Pero-nospora*; attempted treatment; application to the lettuce-disease, *P. Gangliiformis*, Berk. Memoir by M. Cornu.—M. Werdermann replied to M. Reynier's reclamation of priority with regard to the electric lamp. He maintains that his (W.'s) lamp depends not on the effect of incandescence of a heated carbon, but on an extremely small voltaic arc; the incandescence of a small part of the electrode is merely an inevitable consequence.—On an automatic regulator of currents, by M. Hospitalier. This consists of a one-layer resistance bobbin, having a portion of its wire laid bare, and in contact with a slightly convex distributor connected with an armature before an electro-magnet which is affected by the current to be regulated.—On a small telephonic apparatus, by M. Boudet de Paris (sealed packet opened). This refers to a telephone in the form of a watch, which, with a microphone, gives speech well. M. du Moncel referred to a very advantageous arrangement of a speaking microphone (by M. Boudet de Paris), which he would shortly describe.—On the reduction, in continuous fractions, of a pretty extensive class of functions, by M. Laguerre.—On a point in the history of mathematics, by M. Desbovas.—Theorems on prime numbers, by M. Froth.—On a remarkable specimen of silicuret of iron, by Prof.

Lawrence Smith. This piece is remarkably rich in silicium (about 15 per cent.), and is evidently the product of a blast furnace. There are no such furnaces where it was found, but there are some a few miles away, and about 100 miles from the spot was one which supplied iron having 8 per cent. silicium, and gave up working because of want of demand for such iron. Prof. Smith thinks the piece may have been (exceptionally) produced there. M. Daubrée said industry has never been known to produce an alloy of iron with nearly so much silicium. The highest proportion at the Exhibition was 10 per cent.—On a new acid obtained from camphor, by M. Haller.—On the formation of hexamethylbenzene by the decomposition of acetone, by Mr. Greene.—On normal ethyloxybutyric acid and its derivatives, by M. Duvalier.—On the presence of ytterbium in the sylvite of Amherst, by M. Delafontaine.—Existence of baryta and strontian in all rocks constituting primordial strata; metalliferous veins with gangue of baryta, by M. Dieulaufait. He infers from the facts that baryta and strontian have the same origin, viz., the primordial rocks; hence the metalliferous ores (manganese, lead, zinc, &c.), for which baryta serves as gangue, has also this origin.—On the dangers in use of borax for preservation of meat and the reasons why some substances cause meat to lose its nutritive properties, by M. Le Bon. He prescribes, in principle, the use of chemical substances, even the apparently inoffensive salt, for preservation of meat. The most nutritive part of meat is the juice, and this, when the meat is put in saline solution or covered with a salt in powder, makes rapid exchange of its nutritive principles through endosmosis. He hints at a new mode of preservation, however, other than cold.—On an artificial pyroxene (diopside), by M. Gruner.—Influence of atmospheric electricity on fructification of plants, by M. Grandeaun. It greatly stimulates the phenomenon.—On a disease of the coffee-tree observed in Brazil, by M. Jobert.—On the diffusion of heat by leaves, by M. Maguene.—On the power of absorption of water by wood, by M. Maumené. The property varies (for different woods) between 9.37 and 174.88 per cent. of the absolutely dry wood; the latter figure was obtained with chestnut.—On a scientific balloon ascent of October 31, by M. Tridon.

CONTENTS

PARADOXICAL PHILOSOPHY. By Prof. J. CLERK MAXWELL, F.R.S.	141
SCIENCE CLASS-BOOKS	143
OUR BOOK SHELF:—	
“Studies from the Physiological Laboratory in the University of Cambridge”	145
“The American Quarterly Microscopical Journal, containing the Transactions of the New York Microscopical Society”	145
LETTERS TO THE EDITOR:—	
Locusts and Sun-Spots.—E. D. ARCHIBALD	145
The Range of the Mammoth.—Prof. W. BOYD DAWKINS, F.R.S.	146
Fossil Floras of the Arctic Regions.—J. J. WILD	146
The Microphone.—THOS. S. TAIT	146
Leaf-Sheaths and the Growth of Plants.—JOHN MUNRO	147
Hornets.—Wm. WILSON SAUNDERS	147
Equine Sagacity.—M. CAREY-HOBSON	147
Colour-Blindness.—Dr. W. POLE, F.R.S.	148
Magnetic Storm, May 14, 1878.—HENRY C. MANCE	148
“Measuring the Height of Clouds.”—J. F. WILKE	148
The Weather.—G. S. THOMSON	148
THE LAST EXPERIMENTS WITH THE 80-TON GUN	148
THE REGISTRARSHIP OF LONDON UNIVERSITY	149
ABOUT FISHES' HEADS. By Prof. E. PERCEVAL WRIGHT	149
THE BROWN INSTITUTION	151
ON SOME IMPROVED METHODS OF PRODUCING AND REGULATING ELECTRIC LIGHT (With Illustration) By H. WILD	152
INFLUENCE OF THE STRAITS OF DOVER ON THE TIDES OF THE BRITISH CHANNEL AND THE NORTH SEA. By Sir WILLIAM THOMSON, F.R.S. (With Illustration)	152
OUR ASTRONOMICAL COLUMN:—	
Occultations of Stars by Jupiter's Satellites	154
Occultation of 64 Aquarii by the Planet Jupiter	154
The Conjunction of Mars and Saturn, June 30, 1879	154
BIOLOGICAL NOTES:—	
Natural Selection among Salamanders	155
The Muscles of the Mammalian Foot	155
Sensitive Organs in Asclepiadaceæ	155
The Inhalation of Phosphuretted Hydrogen	155
Structure and Affinities of Characæ	156
GEOGRAPHICAL NOTES	156
THE NATURE OF THE ELEMENTS	157
NOTES	158
ON HELIOTROPISM IN PLANTS	161
SOCIETIES AND ACADEMIES	161

m
st
d,
oo
ng
of
ve
ry
so
as
M.
n-
ic
of
ng
a,
nd
he
ta
of
b-
M.
cal
on
is,
in
gh
r,
M.
of
n.
M.
é.
nd
re
of

41
43

45
45

45
46
46
46
47
47
47
48
48
48
49
49
51

52

52

54
54
54

55
55
55
55
56
56
57
58
61
61